JUNE 1956

GAS

New Time-Motion Study Aids Distribution Company

Prevention of Freeze-Ups

A CHILTON PUBLICATION

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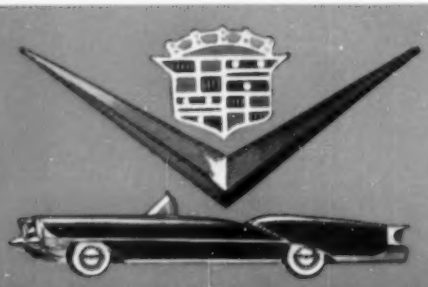

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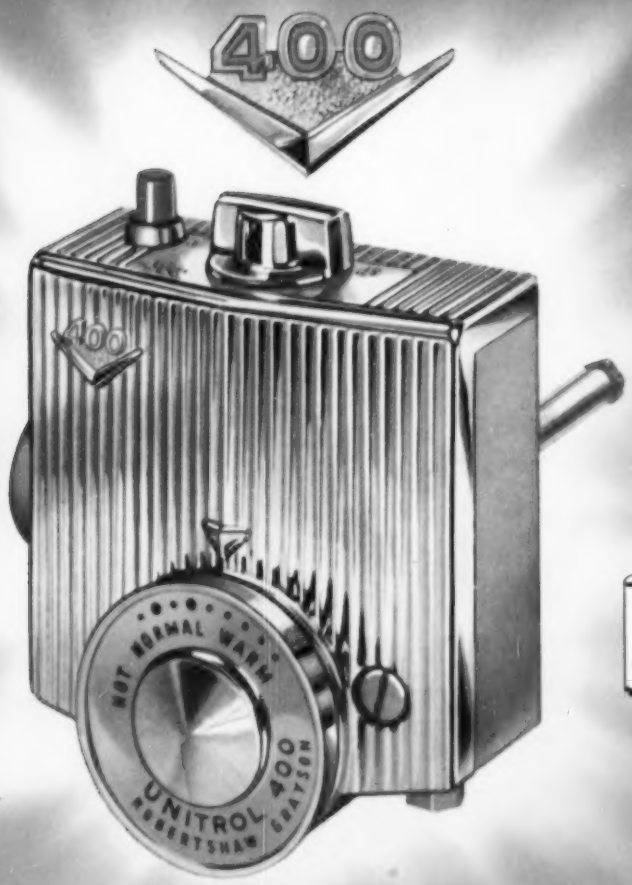

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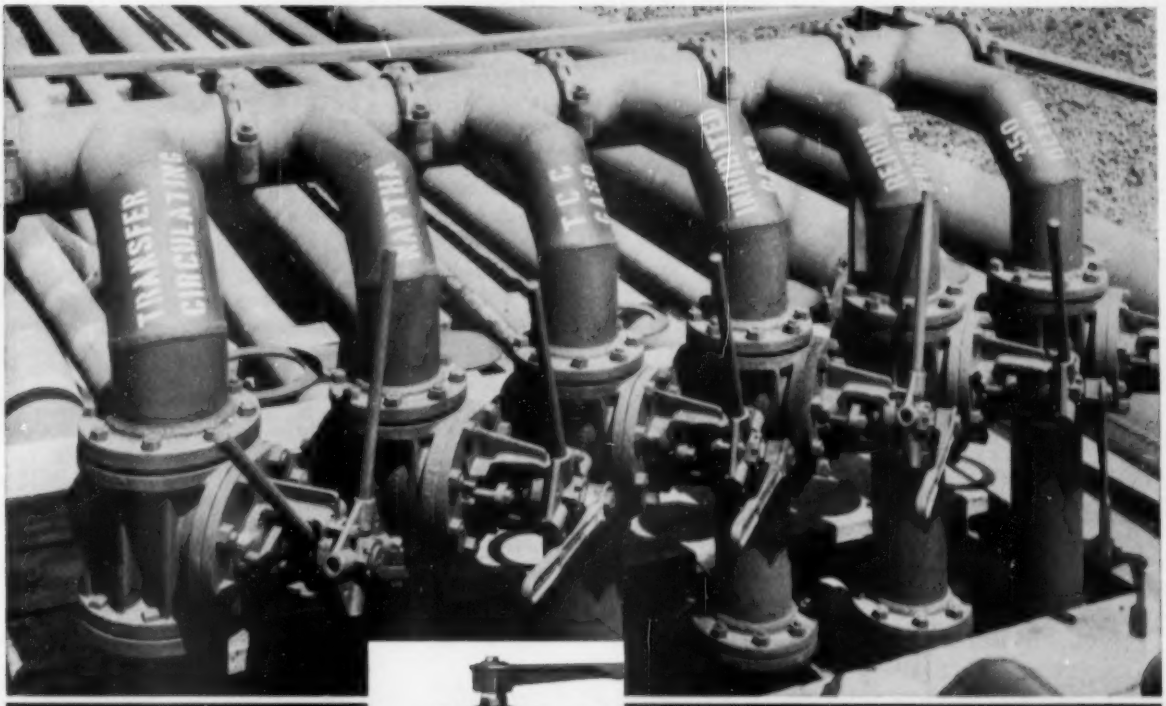

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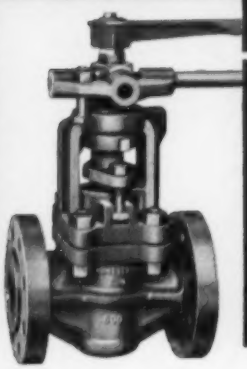

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GAS

32nd YEAR OF PUBLICATION

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GAS is published monthly by the Chilton Co., 198 South Alvarado Street, Los Angeles 57, California. Subscription price: United States and possessions and Canada (in advance): one year, $2.00; two years, $3.00. Mexico, South and Central America, Caribbean Area: one year, $3.00; two years, $5.00. All other countries: $10 per year.
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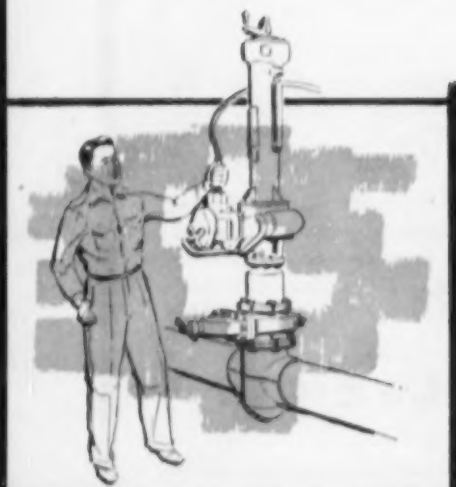
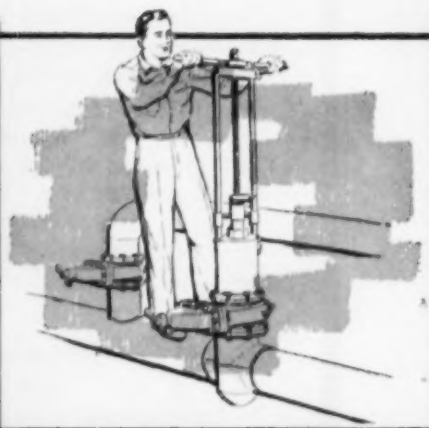
Stopping Machines and fittings are available to fit pipe 1½" through 12". Smaller stop-offs may be made with Mueller Drilling Machines.

MUELLER NO-BLO® Method



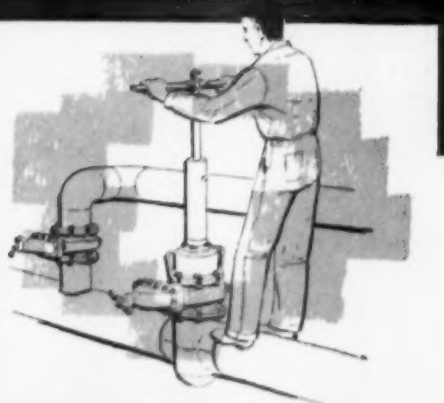
STEP 2: Make cut through pipe. Install Mueller CI-36 or CC-36 Drilling Machine. Engage feed and drill completely through pipe. Retract boring bar, (shell cutter retains coupon), close valve, remove machine.

STEP 3: Attach by-pass line. Weld H-17495 Save-a-Valve Drilling Nipples to pipe above and below stopping machines. Install gate valves – drill through pipe, remove drilling machine and install by-pass line. Open valves.



STEP 4: Make stop-off. Attach steel wedge stopper to shaft of H-17340 Stopping Machine. Bolt machine to gate valve. Open valve – lower and expand stopper. (Repeat procedure on other fitting and the section is completely isolated for tie-in.)

STEP 1: Weld fitting to pipe. Install fitting around pipe. Tack weld halves of fitting together—position and weld to pipe with completion plug in fitting—hand tight. Test the welds for leakage. Attach gate valve to fitting.



STEP 5: Complete tie-in. After line has been tied in and tested, release stoppers and remove stopping machines. Install completion plugs with H-17346 Completion Machine. Tighten plug manually and bolt completion cap in place. Remove by-pass line and cap drilling nipples.

Write for the No-Blo® Method booklet, "Safe Operating Practice." It shows how other gas installations are made in a safe manner, without escape of gas.

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GAS Thermally Thinking

GAS distribution companies need engineers. Engineers, in turn, need recognition for their specialized ability just as all humans need the approval from their fellow men. One of the most disheartening attitudes that fairly consistently plagues engineers in the gas industry—particularly in distribution companies—is the failure of operating people to carry out the concepts and, at times, the specifications of the engineers' design.

Company standards for operations result in recognition of excellent design. Some distribution companies know that a set of operating standards save them important money. Why can't a standards program for operating sections do this for your company?

Your company has standardized to some degree — for instance, each time there is need for a new domestic meter and regulator setting the meter installation crew does not turn to the measurement engineer for a design. Somewhere within your company an operating standard has been developed for this operating step. There should be others. Town border stations can be standardized within limits, the same goes for district regulator stations, industrial meter runs, cathodic protection measurement and installation techniques, fencing, meter and regulator station buildings, and on and on, ad infinitum.

Does standardization save money? Ask one of the gas companies that seriously exercises such a program. It makes sense. If methods of design and field construction are standard, it takes less time to train new men; it takes less time for trained men to fabricate and construct a standard installation; time means money and lot's of it these days.

Things fit in modern industry. An odd statement? Yes, but it is the basic way of saying that the American Standards Association and associated organizations have been at work for you for many years to make sure that materials are sound, manufacturing techniques are proper, testing procedures are realistic, and that dimensional properties of products are held within established limits. The engineer who designs an installation does not have to worry about the fit of components or their other specified properties. They were built to standards. This idea can carry over into many facets of your operations.

A workable way to start a standards program in your company is to form a committee of key operating supervisors and engineers. Let them meet on a regularly scheduled basis and the interchange of ideas will congeal to form the best, the standard way of doing things. Back their decisions with authority. Some gas companies set up standards programs, but then let the men in the field run rough-shod over the standard practices for design and installation that have been established.

Company standards are a management tool. They must be administered as such. Reasonable care of the tools is important as are periodic repair, revision, and general upgrading. Do not let standards stifle initiative. Your standards committee, if operated with the desired degree of democratic autonomy, will prevent this. Company standards will mean that sound engineering goes into your gas system construction and the committee will effect the balance that will eliminate engineering that is a little too sound. Such programs have worked for others—they will work for your company.

Standards evolved from a meeting of minds among both engineering and operating people mean economy, efficiency, and safety for your company. Can you fail to save money with these factors working for you?

J. Fred Ebdon

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A CHILTON PUBLICATION
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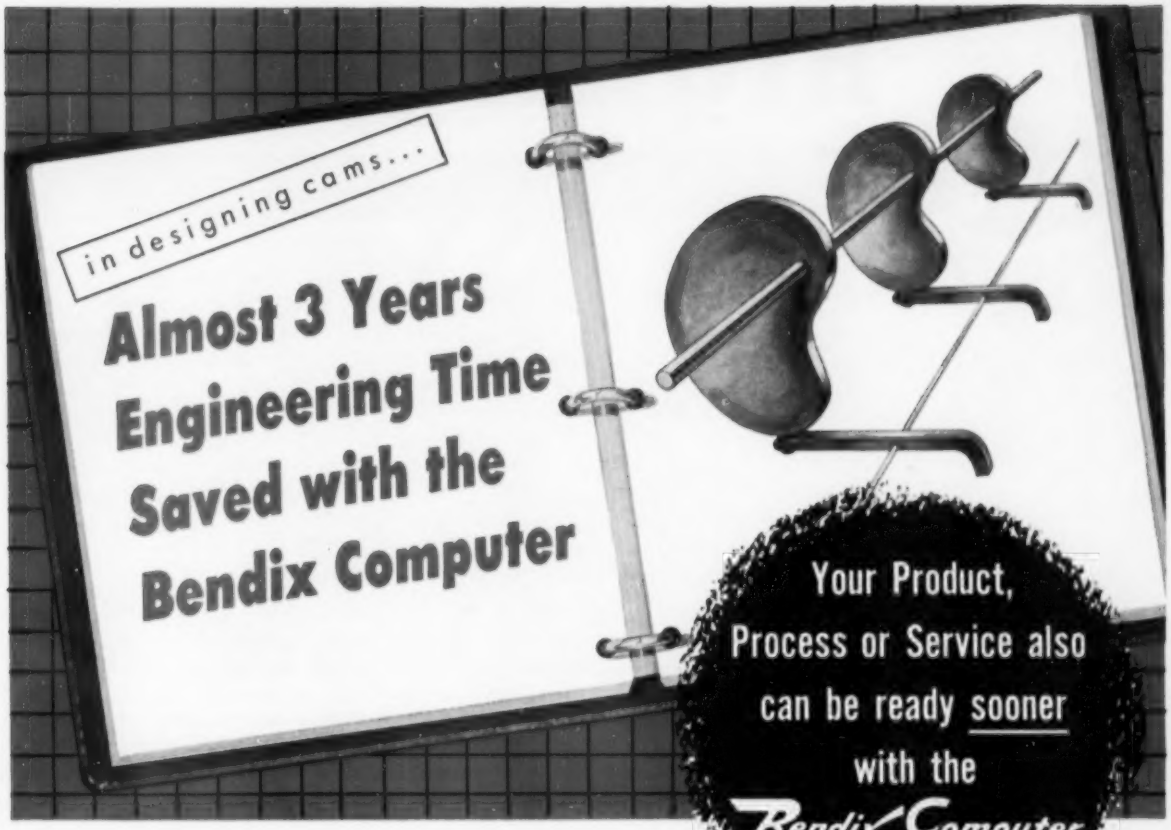
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highlights

GAS SPOT NEWS, TRENDS, COMMENT ON GAS INDUSTRY AFFAIRS

Industry launches PR workshops

Public relations in the utilities end of the gas industry has been in the spotlight often since the recent in-fighting during and after the now-defunct Harris Bill ran its course and was chopped down by the presidential veto. Focal points of public relations on an industry-wide basis will be eight public relations workshops being organized for geographical areas of the nation. The kick-off will be the Mid-Eastern Public Relations Workshop to be held at Atlantic City, N. J., this month. They are PAR Public Information Programs. It is good to note that representatives from every gas company in each area, *whether or not* AGA company members or PAR subscribers, are most welcome and urged to come.

McMahon drops plan for alternate Trans-Canada line

In a recent telegram to Canada's Trade Minister Howe, plans for an alternative Alberta-to-Montreal natural gas pipeline were abandoned by Frank McMahon, Calgary, president of the now-abuilding Westcoast Transmission pipeline. The proposal was an alternate to the franchise currently held by Trans-Canada Pipe Lines Ltd. Mr. McMahon dropped his proposal to build the Canadian-owned, privately financed gas line that he asserted was economically feasible if the Trans-Canada line failed to break its deadlock, because he feels he is too seriously committed to his Westcoast Transmission pipeline project. The wash-out of McMahon's proposal came as a surprise to the Trade Ministry.

Distribution companies turning to automation

Automation seems to be coming into the distribution part of the gas industry as quickly—if not more quickly—as in the transmission segment. Distribution operators are turning to ring-balanced flow meters for remote measurement that uses mechanical analogue to digital conversion to read-out corrected-Q on counters that give specific or summed flow volumes.

Other systems in distribution operations use slide-wire system to convert from analogue to digital flow values in remote measurement of gas.

From an editor's field book

Trekked from Eunice, La., to Detroit, Mich., during latter April and early May, to see how construction on the remaining uncompleted sections of the American Louisiana pipeline are coming along . . . on the southern spreads, particularly in Louisiana, they were having nice weather and the contractors were rolling to get out of the rice farming areas before time for the farmers to flood their rice paddies . . . when we were there, rice was doing well and was ready for water . . . pipeline construction was also doing well and should get out of the farmers' way . . . just another example of how the gas industry tries to get along with the people from whom it gets ROW for pipelines. Weather on the remainder of American Louisiana's route was lousy . . . rain all the way . . . no doubt they will have to throw extra spreads into the picture to beat the set-back from nature . . . noticed a unique mobile gas compressing lash-up on the pipeline . . . American Louisiana will take gas from Texas Gas Transmission at a meter station near Slaughters, Ky., and use the mobile compressor unit for increasing pressure to test the pipeline in accordance with the ASA B31.1.8-1955 Code.

Noticed that a taxpayer who elects to deduct intangible drilling and development costs for gas wells from income taxes does not have to add these deductions in computing the limitations on deductions under section 270 of the 1954 Internal Revenue Code . . . the gas industry will probably be among the targets of the Senate-House Economic Committee that is scouring recent wage, price, and profit trends in major raw materials industries . . . no doubt they hope to turn up some fodder for sensational public hearings . . . the Office of Defense Mobilization is tightening up in granting fast tax amortization aid for the construction of new gas pipelines from the Gulf Coast to Eastern markets.

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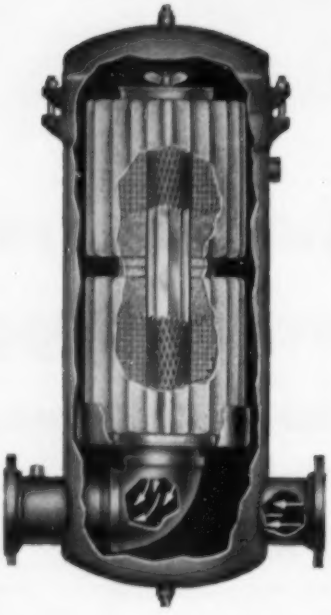

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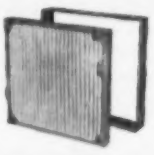

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*regulatory and legislative trends

FPC denies natural gas for boiler fuel

IN a recent decision, which is significant for the entire gas and electric industries, the Federal Power Commission by a three to two vote denied the proposed sale of large volumes of natural gas for steam electric generation. Two commissioners, Digby and Stueck, dissented against such control of the end-use of natural gas. Conservation of natural gas for uses superior to that of boiler fuel has been a recurring problem before FPC. With Commissioner Draper retiring this month the views of his successor will be important in determining how the majority votes in future cases.

Natural gas has grown to supply 25% of the nation's total energy furnished by coal, petroleum liquids, water power and natural gas. During 1954, natural gas was a very important boiler fuel for the electric industry in the United States. For the tremendous electric utility production of 472 billion kilowatt hours in 1954, natural gas was the third largest source of primary energy, being 20% of the total of all sources. The other primary energy sources for electric generation in the United States, and their proportionate contributions were: Coal 50%, hydro 23%, and oil 7%.

With more than 100 million people in the United States depending on the comfort and convenience of natural gas, the subject of conserving gas for uses superior to burning it as boiler fuel becomes noteworthy. An analysis of the views of the FPC commissioners should be helpful. First, let us consider the presiding examiner's decision, which was affirmed by a majority of the commissioners.

Examiner weighs conservation and economics

The presiding examiner denied authorization to Northern Natural Gas Co. to build pipeline facilities costing $131,000 to deliver more than 100 MMcf of gas daily, on an interruptible basis, to the Black Dog power generating station owned by Northern States Power Co.

The examiner gave these reasons:

"Because applicant can use its present gas supply to meet the requirements of the general public, it should not be permitted to dissipate that supply through any inferior use such as boiler fuel. Moreover, applicant and other natural gas companies have witnessed and experienced an ever increasing wholesale price spiral. Accordingly, gas withdrawn by applicant from sources presently attached to its system can only be replaced from other sources at substantially higher prices, and the probability is that if the present upward trend of field prices continues, the greater the withdrawal, the higher will be the price paid for replacement gas." • • •

"Nor should the fact be overlooked that while there is an abundance of coal to take care of any demands that may be placed upon industry, the same cannot be said of the reserves of natural gas. Accordingly, the conservation of gas for the use by the public for more highly beneficial purposes makes it necessary to apply conservation measures wherever possible.

"Conclusion: This is a case in which a sale is proposed to be made, but in the examiner's view ought never to be permitted to be made, at less than commodity cost; where applicant's other customers would be forced, if the application is granted, to shoulder a portion of the commodity cost, creating unreasonable preference and discrimination between types of customers; where conservation of natural gas should be controlling; where coal is readily and economically available and now in use in the Black Dog plant; and where factors are present which more than counterbalance claimed benefits to applicant and Northern States. Accordingly, there is no basis upon which it can be found, as Section 7(e) of the Natural Gas Act requires the commission to find, that the proposed service 'is or will be required by the present or future public convenience and necessity.'

"The examiner recognizes, of course, that the commission has no jurisdiction over rates charged for direct consumer sales. But the commission does have jurisdiction over the construction and operation of facilities through which such sales are made, and in reaching its decision as to whether such facilities are required by the present or future public convenience and necessity it must scrutinize the proposed direct sale price and make certain that it will not work an injustice insofar as jurisdictional sales and ultimate consumers are concerned."

Views of the commission majority

Chairman Kuykendall wrote a concurring opinion in which he stated that he did not subscribe to all that is said in the main opinion, but that he agreed with the result reached, "because I am unable to determine, from the record, that the revenues which would be derived from this sale are adequate to recover the costs" properly allocable to that service.

The FPC main opinion declares:

"In general, we concur in the result reached by the presiding examiner. The issue is whether the public convenience and necessity require the authorization sought, involving the use of natural gas for boiler fuel. As we have heretofore determined, in passing upon the issuance of a certificate under Section 7 of the Act, there is no valid objection to giving matters of conservation, inferior and superior uses and related mat-

*A monthly commentary on national and state developments by an expert in the field of utility law.

ters the weight they may deserve on the facts of a given case, short of assigning to them alone determinative weight. These also are factors to be weighed and evaluated along with other relevant circumstances in assaying the public convenience and necessity. And we have 'repeatedly held that the use of natural gas as boiler fuel is an inferior usage and that, while it is not to be denied in all situations, it should be permitted only on a positive showing that it is required by public convenience and necessity.' *In the Matter of Mississippi River Fuel Corp.*, Opinion No. 250 and accompanying order, issued May 11, 1953, Docket No. G-1955, page 5.

"On balance, as appears from the presiding examiner's decision, the detriments to the public which would result from authorizing Northern's proposed operations outweigh such benefits as might flow therefrom, and Northern has fallen short of the positive showing required by the public convenience and necessity. Weighing against authorization, the sale to Northern States would aggravate the gas supply problem which increasingly perplexes Northern and most other natural-gas pipeline companies as well in these days of diminishing reserves and increasing demand. In this connection, the record lacks the evidence necessary for us to evaluate the future effects on Northern of the proposed sale in creating a need for additional reserves. Furthermore, a persuasive showing has been made of the adverse impact of the sale on economic conditions in areas supplying coal for the Black Dog plant.

"Moreover, while there is an abundance of coal readily and economically available to meet the Black Dog plant's foreseeable fuel demands, the same cannot be said of natural gas. And the story is generally the same in most of the great fuel-consuming areas across the nation. The limited quantities of such a premium fuel as natural gas, so uniquely adaptable to so many superior uses, as contrasted with the enormously more abundant supplies of coal, have important implications for the public interest which we cannot igore in passing upon a proposed boiler fuel sale. Obviously, in circumstances such as these, considerations of conservation must be given appropriate weight, particularly in view of the substantial volume of natural gas in question and the extent of Northern's present and prospective market requirements for more desirable uses of gas. Other detriments which would result from authorizing the operations proposed are sufficiently stated in the presiding examiner's decision.

"In comparison, the benefits which it is said the proposed sale would yield, including possible additional revenues which might accure to the benefit of Northern's utility customers, an improvement in Northern's system load factor, and claimed savings to Northern States in fuel costs, are relatively meagre and uncertain of realization."

Commissioner Connole added his opinion thus:

"I am in complete agreement with all the conclusions of the majority report, and with the reasons advanced in support of them. Because I have additional and more universally applicable reasons for reaching these conclusions, however, I append this separate statement explaining the basis for my convictions with respect to the boiler fuel problem in fuel-competitive areas and the doubtful wisdom of depending on boiler fuel sales in such areas in attempting to make low-load factor, high-volume sales more profitable." • • •

"An understanding of my convictions on certain basic economic characteristics of the pipeline business is necessary to an intelligent appreciation of my position here.

"It is obvious that once the latent energy locked within a given reserve of natural gas is released through combustion the act is, for practical purposes, final. A valuable source of energy is thereby that much depleted. It is no longer of any value as a source of heat, or electrical or mechanical energy. Thus it becomes essential to discriminate among the uses to which energy is put after its release by the combustion of natural gas. Will that energy be used to develop maximum values that are realizable in such processes? Experience with this problem shows that when resources may be devoted to several uses of unequal utility and are used in any other than the manner of greatest utility, a cost or loss is incurred amounting to the difference between the respective utilities of the several uses; that to which the resource is put and that of the highest utility.

"Under given circumstances this 'opportunity' cost may, of course, be a reasonable price to pay for realized benefits. For example, through the use of natural gas as boiler fuel electric energy may be made available for domestic and commercial heat, light and power at prices which bring it within the reach of many who would be unable to obtain it otherwise. Indeed, through load factor improvement or otherwise, use of natural gas may act indirectly to reduce the cost of providing gas for space heating and other low-load-factor uses. However, no such immediate advantages are shown by this record to be foreseeable from this sale. Indeed, because this sale would be made in an area where alternative fuels are priced within a competitive range of the price of natural gas, no such advantages are possible.

"As a general proposition, in fuel-competitive areas where the cost of equivalent energy from sources alternative to natural gas is near to equilibrium or closely approaching equilibrium, it is false economy and wasteful investment to construct facilities and to cut prices in order to maintain boiler fuel sales of natural gas. Better not to have developed the space-heating load at all than to do so in the face of approaching equilibrium of gas and other fuel costs. For, when the price advantage of natural gas disappears, so will its usefulness as a means of filling off-peak voids. In areas of close fuel competition, load factor built on relative expensiveness of coal and fuel oil may be a worse than doubtful economy." • • •

"The problems faced by Northern and other pipelines in fuel-competitive areas distant from producing areas will be aggravated, not solved, by dependance on the illusory benefits of uneconomic sales such as the one proposed. It is the responsibility of this commission to prevent the waste of this valuable resource in pursuit of this economic will-of-the-wisp. It is a responsibility shared by pipeline, distributing company, consumer and commission to seek the soundest solution to these problems. The granting of the authority sought here would be inconsistent with both."

Commissioners Digby and Stueck dissent

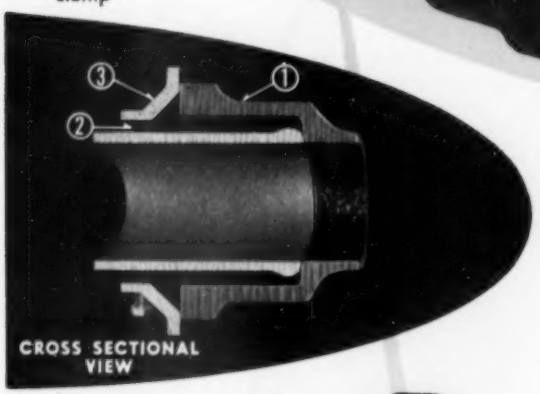
The two dissenting commissioners asserted:

"It is our firm conviction that although Congress gave this commission vast authority over a determination of a policy with respect to conservation

Continued on page 90

Simplified Bell Joint Clamps

1. Bell joint
2. Perma-Seal Compound
3. Bell joint clamp



SEALED BY ADHESION

WITH PERMA-SEAL COMPOUND

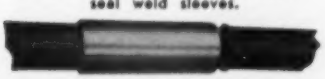
WITH THE FOLLOWING ADVANTAGES:

- Smaller street openings required because no excavating or cleaning necessary in back of the bell.
- The clamp does not require adjustment, or filling and facing of the bell.
- ***The clamp is engineered to fit all variable pipe wall thicknesses without adjustment and to fit all types of bell joints including sleeves, drip pots, valves and odd size pipes.*** Available sizes: 3" to 36" diameter.
- This clamp fits in confined areas because it requires no greater area than the existing bell for installation.
- ***This leak clamp becomes a seal by adhesion rather than by compression.***
- This clamp allows ground movement and vibration to take place without the danger of leaks after installation.
- Once installed the joint becomes trouble-free and permanent.

Write: for full information and prices about the Newest Method in Pipe Connections

New Perma-Seal and Safety Seal Weld sleeves available for steel to steel, steel to cast iron, split sleeves for repair of steel pipe, and completely insulated sleeves for corrosion control.

Typical installation in the removal of valve and replaced with safety seal weld sleeves.



Steel to steel sleeve

Cast to cast sleeve

UNITED PIPE UTILITY SUPPLIERS, INC. BOX 777, BELOIT, WISCONSIN

Kissed or KICKED

Whether lightly kissed by low pressure variation or kicked by high pressure gas, Vulcan diaphragms always react as they should . . . instantly, accurately, reliably. Field service records of Vulcan Synthetic Diaphragms prove that resilience, strength and impermeability are retained after long years of service and millions of cubic feet displacement. 8 out of 10 regulators and controls today utilize Synthetic Diaphragms.—Do yours?

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WASHINGTON

As summer comes to Washington...

AS the spring-like month of May edged its way along Washington's progression to the summer, politicos sharpened their cries, took a hitch in their belts, and continued to unmuffle the political drums that will beat so loudly this presidential election year. Even now, the hinterlands are sending forth cries of cheer and anguish as the farmers have been brought into the tangle early so that both parties can get a running start at the farm problem. As much as one may wish to avoid it, the average citizen, the successful businessman, the gas industry men—from top to bottom—must become aware of the farm "problem" and the influence the farm interest has on government.

Reminds one of the recent jungle fighting over the defunct Harris Bill. No doubt but that the farm bloc has some influence in Washington too. The Presidential veto of the "Farm bill" took courage as did his same action in the case of the Harris bill. Most Congressmen secretly admire Mr. Eisenhower's stand on these two matters—particularly during an election year. As for the Harris bill, leaders in Congress and in the Administration are saying in private that despite—or maybe because of—the unfortunate black eye the gas industry received this year, producers, pipeliners, and distributors had better get a bill in shape for the next session of Congress unless they want to continue with the independent gas producers being slowly and reluctantly controlled by the FPC.

Speaking of the Federal Power Commission, it is interesting to note that they are now operating under a new "open-door" policy brought on—at least in part—by a Congressional investigation of secrecy in government agencies.

Under the new set-up, FPC has abandoned rules which a House Information Subcommittee had criticized as giving commission officials "almost unlimited power" to suppress information. FPC will now make public all of its opinions and orders which it formerly could keep secret "for any good reason." The public will now have access to eight different kinds of records that were unavailable under the former policy.

In the trail of the sensational Case case, leaders of both political parties now admit to themselves that the lobby investigations were hastily conceived and tended to embarrass everyone. No legislation to actually control lobbies and/or campaign gifts was forthcoming and if there was any guilt it was passed off with an unusually anemic wrist slapping. True, there was some "ineptness" (actually it was comical. Ed.) and overzealous conduct in the heat of the gas bill controversy. We needed a Congressional investigation to tell us that?

A second and broader lobby investigation is now started and is coyly taking swings through the air with poor aim and little "heart" in the project. This "work" will be done by a special committee headed by Senator McClellan (D-Ark.). The pace was set by Maston Nixon, Corpus Christi, Texas, independent producer who appeared at his own request to tell about his work as chairman of the deceased General Gas Committee. Mr. Nixon wanted to hurry what he know would be a command performance so that it would not interfere with a planned trip to Europe.

The Washington feeling is that some gas industry people will be embarrassed by this probe and it will manage to keep alive the ill will for the gas industry created by the Case affair. However, this seems to be the popular sport these days in Washington as both parties pry and probe for a tender spot in an unprotected place in the other's anatomy. As a full-scale political circus, the McClellan investigation will be third rate and will fail to match previous billings under the Congressional tent. Certainly, it is not expected to produce any legislation.

Some interesting testimony has been in the behind-the-scenes talk when the matter of the Tennessee Gas Transmission Co., Midwestern Gas Transmission Co., Iron Ranges Natural Gas Co. hearings (Dockets G-9448, et al) are discussed by Washington gasmen. In response to questions by Counsel Shannon for Michigan Wisconsin Pipeline Co. and American Louisiana Pipe Line Co., B. E. Lowe, sales manager for Trans-Canada Pipe Lines Ltd., said than Trans-Canada has no specific agreement with TGT as to the volume of gas Tennessee Gas is to take at Niagara. Previous testimony by Tennessee's Vice President Freeman had stated that TGT could take about 100 MMcf/day at this point if said volume were available. Mr. Lowe also stated that the rate schedules presented in various exhibits he has sponsored apply only to sales made to distribution companies operating in Canada and do not necessarily apply to sales that might be made to United States customers, such as TGT at Niagara and at Manitoba. He also mentioned that Mr. Freeman of TGT has never told him what use TGT intends to make of any natural gas it purchases from Trans-Canada at Niagara. As other questions mounted on Mr. Lowe as to the disposition of the 100 MMcf indicated as unallocated at Niagara, he indicated that it is expected that most of this volume will be sold to customers west and north of Niagara, but

Continued on page 91

GIANT gravity-defying sentinels of high strength alloys, armed with nuclear weapons, may be able to hover near centers of aggression ready at an instant's notice to drop destruction that will make war too deadly to risk.

100 years from now...

WE MAY MAKE WAR IMPOSSIBLE!

Scientists, looking ahead, envisage a fabulous future...full of wonderful new products that will bring civilization a whole new era of progress. But, even then, our gas and water will still flow through the same dependable cast iron pipe being laid now.

Here's proof! Today, more than 60 American cities and towns are being efficiently served by the same cast iron water and gas mains laid over 100 years ago. What's more, modernized cast iron pipe...centrifugally cast and quality-controlled ...is even stronger, tougher, more serviceable.

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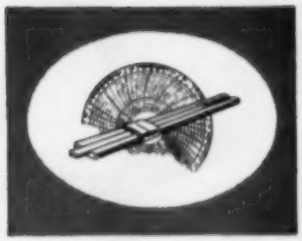
A WHOLLY INTEGRATED PRODUCER FROM MINES AND BLAST FURNACES TO FINISHED PIPE.

technical trends



• By GUY CORFIELD

Micro-miniature vacuum tubes

In the June 1953 issue of *GAS* there was a description of the transitor, the semi-conductor rectifier-amplifier that was then causing a sensation in the electronics field and promising, with its minature size, and ruggedness and other properties, to make the historic vacuum tube obsolete. General Electric research laboratories were not satisfied to abandon the vacuum tube, however, for one reason because the transitor would not operate at high temperatures, and they have now revealed the development of a micro-miniature *ceramic* electron tube that is again revolutionary for certain applications.

This new tube is as small as the transitor—⅜-in. long and 5/16 in. in diameter. It is made of alternate ceramic and metal layers or rings, the metal being principally titanium. The first commercially available tube is to be the 6BY4 rated for use as a radio frequency amplifier for frequencies up to 1000 mc/sec. This type of tube can operate at temperatures up to 500°C (932°F), and is expected to speed improvements in UHF-TV and military equipment such as guided missles.

Rechargeable flashlight battery

Periodically the thought or desire arises to recharge flashlight batteries, rather than throw them away after relatively short life. However, this has not been successful with any convenient type of cell that has previously been available. The Gould-National Batteries Inc., St. Paul, Minn., is now announcing the development of a rechargeable, hermetically sealed nickel-cadmium battery. It uses potassium hydroxide as the electrolyte and develops approximately 1.25 volts per cell.

A consumer package consisting of a two-cell flashlight and a charging unit is now available, the cells being identified with the name "Multi-Lite." While the initial cost of a cell is greater than that of a regular dry cell, it can be recharged more than 200 times providing a lifetime cost far below that of the dry cell. It is claimed that under- or overcharging does not deteriorate the Multi-Lite battery. While it does not now appear to be a suitable substitute for existing types of storage batteries, it would seem to have general application to many types of flashlights and lanterns, and other special purpose uses.

Argon, now a not-so-rare gas

Argon is one of the so-called rare atmospheric gases, being present in normal air at a concentration of about 0.8%. It is a monatomic gas with an atomic weight of 39.9 and specific gravity (air equals 1.00) of 1.38. Its boiling point is—185.7°C (—302°F) between oxygen and nitrogen.

Up until World War II argon was very little more than a laboratory curiosity, but its use and production have since developed to a present volume of well over 200 MMcf annually. It is a chemically inert gas and for this reason has become increasingly important for the following principal industrial uses: cutting and shaping of non-ferrous metals; electric arc welding of steel, stainless steel, aluminum and magnesium, wherein it is used as an inert gas shield —preventing oxidation and otherwise performing better than other inert gases such as nitrogen and helium; production of incandescent light bulbs and electronic tubes, over 90% of which are now filled with argon; and production of titanium wherein it is used as an inert "blanket" in certain stages of the process.

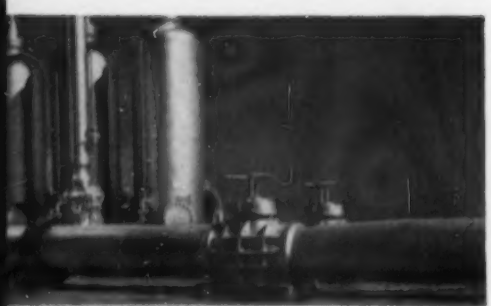
Argon is obtained from air by compression and cooling to liquefaction, followed by fractional distillation, both directly as a product of air liquefaction and indirectly as a by-product from "tonnage oxygen" plants. It can be obtained at a purity of 99.9%, either as a compressed gas in cylinders or as a refrigerated liquid. The current cost varies from 9 to 12 cents per cu ft depending on the quantity, type of delivery, etc. Its use is expanding so rapidly that the U. S. Department of Commerce estimates that by the end of 1956 there will be 12 companies operating 21 plants with a production capacity of 550 MMcf/yr.

Shale oil reserve estimates rise

Periodically we read about the enormous quantities of oil potentially available in the Colorado oil shale deposits. In 1951 the U. S. Bureau of Mines estimated the oil in highgrade shale at 439 billion bbl, and just recently the U. S. Geological Survey raised this figure to 900 billion bbl, stating that the potential oil production is considerably greater than that of the petroleum reserves of the entire world.

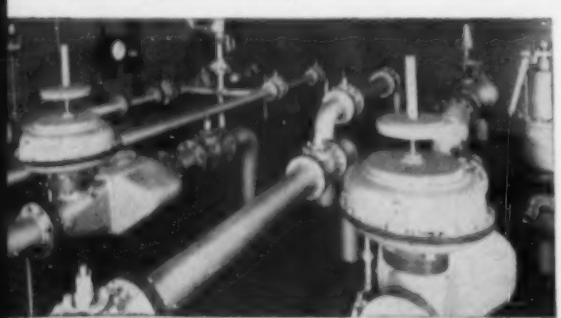
The USGS estimate included only shale which will yield 15 gal. of oil or more per ton, and stated that 190 of the 900 billion bbl will be available from shale yielding 25 gal. or more per ton. They concluded that this oil will not be economically usable in the near future, but that by 1960 there may be commercial oil-shale treating plants in operation which then might be able to produce oil at approximately 15 cents per gallon.

On ANY Leakproof, Rockwell —



ON TRANSMISSION SERVICE, Rockwell-Nordstrom valves assure dependable control because quarter-turn, lubricated closure is two to five times faster than ordinary valves.

AT GAS COMPRESSOR STATIONS, you'll always see Rockwell-Nordstrom valves because at any pressure differential they operate easily and quickly, can be lubricated, packed and adjusted under pressure.



IN GAS REGULATING STATIONS, Rockwell-Nordstrom valves' pressurized lubricant sealing assures leakproof valve service. A glance at the wrench tells you immediately if the valve is open or closed.

FOR METER SETTINGS, Rockwell-Nordstrom valves (shown here with Rockwell meter) are widely used because they always close quickly in an emergency. Also, vital parts are completely protected from weather.

Gas Service...!

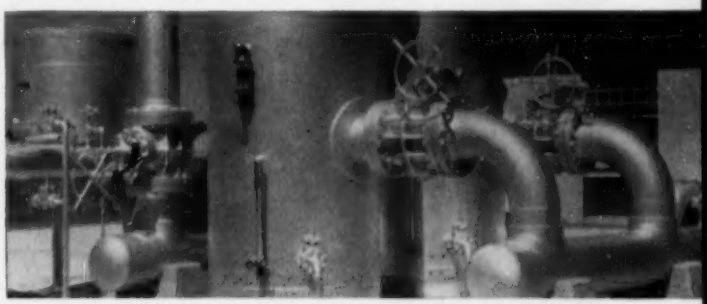
Trouble-Free

—Nordstrom Valves Cut Costs

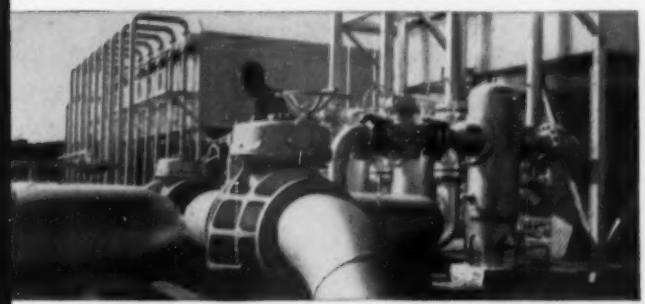
Rockwell-Nordstrom, *the original* lubricated plug valve, has been cutting costs in the gas industry for forty years. The unique Sealdport* pressure lubrication system assures safe, leakproof gas service at any pressure. Rugged design and lubricant film protection greatly reduce repair, replacement and down time costs. These facts have been *proved* on every type of gas service from the well head to consumer services.

Rockwell-Nordstrom is *the only complete* line of lubricated plug valve sizes and types. On any gas service, there is a Rockwell-Nordstrom valve that will do the job better and at lower cost than any other valve you've ever used. Write for more information today: Rockwell Manufacturing Company, Pittsburgh 8, Pennsylvania.
Canadian Valve Licensee: Peacock Brothers Limited

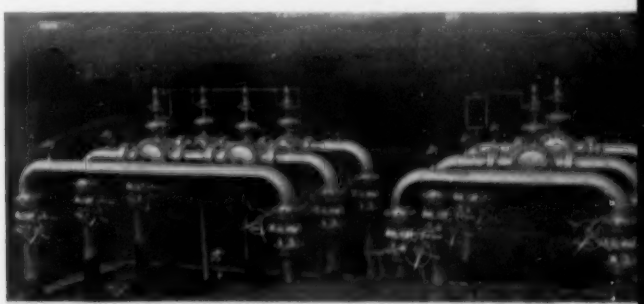
AT THE WELL HEAD, Rockwell-Nordstrom valves prove best because they can be lubricated, adjusted and repacked under pressure. Lubricant jacking assures *instant* operation.



IN SCRUBBER SERVICE, lubricant protection of working parts plus unexposed seating eliminates corrosive-erosive field gas problems when you use Rockwell-Nordstrom valves.



IN UNDERGROUND STORAGE INSTALLATIONS, pressure lubricant sealing for positive shutoff means *safe*, dependable control at high pressure when Rockwell-Nordstrom valves are specified.



FOR TOWN BORDER STATIONS, Rockwell-Nordstrom valves are dependable, whether the valve is operated once a year or many times a day. Pressurized lubrication assures *instant* operation.

AT THE CONSUMER'S PLANT, automated Rockwell-Nordstrom valves, shown here on gas fuel lines, are ideal for power operation on *any* service because they close with a smooth, easy quarter-turn.

ROCKWELL-
Nordstrom VALVES

LUBRICANT SEALED FOR POSITIVE SHUT-OFF

40th Year *of lubricated plug valve leadership*

*Registered T.M., Rockwell Manufacturing Company

FISHER Rugged

TYPE 630

FOR INLET PRESSURES UP TO 1500 psi

Fisher's famous Big Joe Type 630 is the best regulator for rugged high pressure jobs. It's ideal for Farm Taps, Small Border Stations, and Industrial Installations. For completely dependable service, there is no regulator like the Big Joe — it's backed by thousands upon thousands of installations along the major pipe lines of this country.

TYPE 620

MAXIMUM OPERATING INLET PRESSURES UP TO 750 psi

(Maximum allowable inlet pressure 1000 psi)

The Fisher Type 620 pounds to pounds regulator is especially designed for economical first stage reduction of gas pressure for farm taps on high pressure transmission systems.

Also suitable for industrial gas applications, as a Propane tank reducing valve, and for numerous other installations where good regulation is required on gas service.

Write for New Fisher Bulletin P-11.

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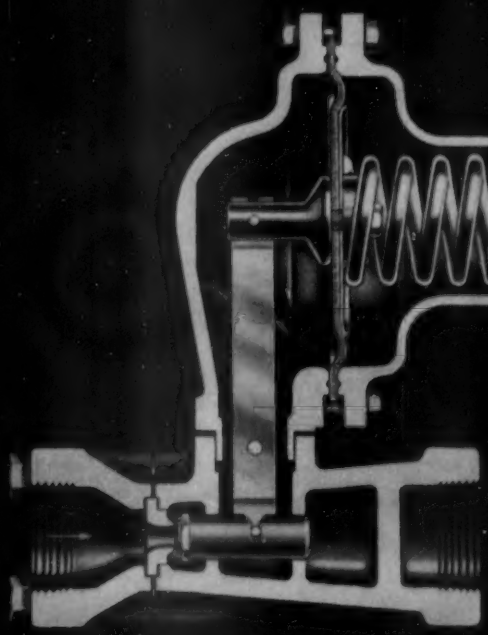
LEADS THE INDUSTRY IN RESEARCH FOR

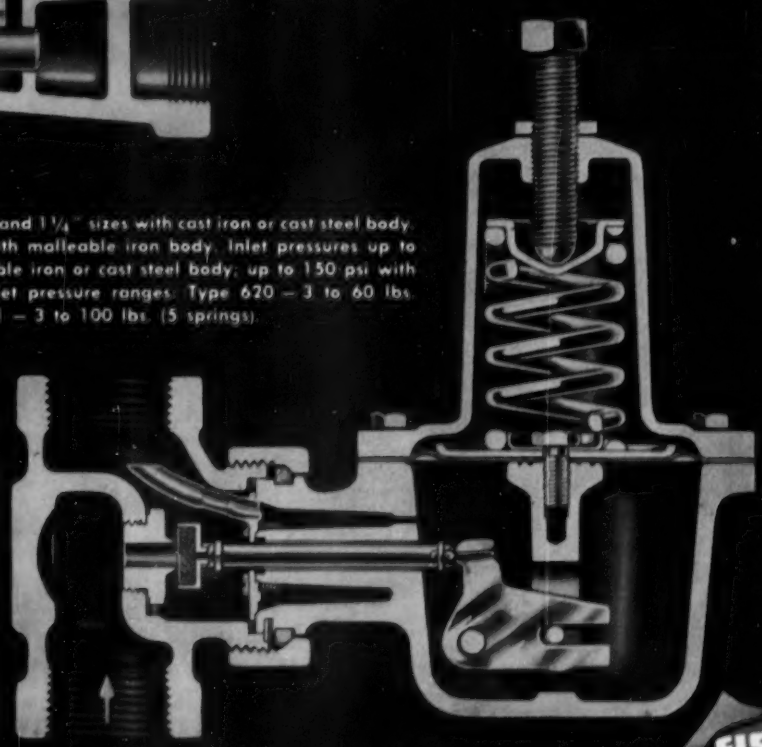
Regulators for High Pressure Jobs

...for POUNDS to POUNDS SERVICE



Available in 1" and 2" sizes with forged steel inlet for pressures up to 1500 psi and outlet pressures 5 psi to 200 psi. Valve disc material suitable for tight shutoff at all inlet pressures. Spring ranges for 5 to 200 lbs. reduced pressures.

Available in ¾", 1" and 1¼" sizes with cast iron or cast steel body. ¾" and 1" sizes with malleable iron body. Inlet pressures up to 750 psi with malleable iron or cast steel body; up to 150 psi with cast iron body. Outlet pressure ranges: Type 620 – 3 to 60 lbs. (4 springs). Type 621 – 3 to 100 lbs. (5 springs).



• • • **Marshalltown, Iowa**

BETTER GAS PRESSURE CONTROL

FISHER

Since 1880

They bought on faith

Photo: Ewing Galloway

This is Providence, seaport and largest city, also the capital of Rhode Island.

Print: Bettmann Archive

This is Providence as it looked in the early 19th Century, over 100 years ago.

CAST IRON

The Q-Check stencilled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.

MODERNIZED cast iron

100 years ago– they buy on proof today

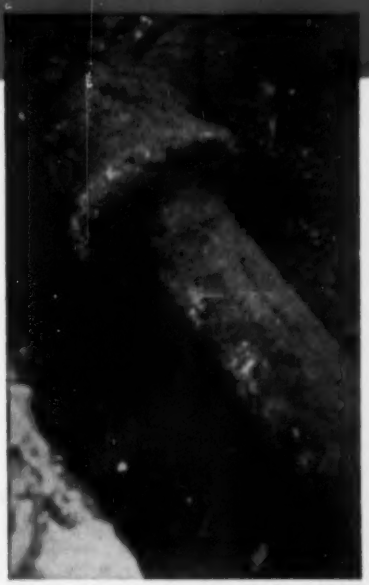
Providence Gas Company bought cast iron pipe 100 years ago– and still buys it.

Providence Gas Company was granted its original charter in 1847. Population of Providence was then about 36,000. Today this Company is serving approximately 100,000 customers in Providence and adjacent cities and towns. The distribution system contains about 950 miles of mains, more than 80% of which is cast iron pipe.

Providence Gas Company, and public utilities in over 60 other cities, bought and installed cast iron pipe for underground mains that have been in continuous service for more than a century. They bought on faith founded in good judgment. Today, they continue to buy cast iron pipe because they have *proof*—proof of the long life, dependability and economy of this time-defying pipe.

Today's *modernized* cast iron pipe—centrifugally cast and with standardized mechanical joints, is even more economical and efficient. The pipe is stronger, tougher, more uniform in quality. The mechanical joints are bottle-tight for usual gas pressures and for all types of gas.

Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Ave., Chicago 3, Ill.



This cast iron pipe, installed in 1852, is still in service in the gas distribution system of Providence Gas Company, Providence, Rhode Island.

A FEW OF THE 35 GAS UTILITIES WITH CENTURY-OLD CAST IRON MAINS IN SERVICE

Peoples Gas Light and Coke Co., Chicago—Consolidated Gas Electric Light and Coke Co., Baltimore—Philadelphia Gas Works—Richmond Gas Works, Richmond, Va.—Hartford Gas Company, Hartford, Conn.

pipe FOR MODERN GAS DISTRIBUTION

Help Wanted

FOR A VITALLY IMPORTANT

Twelve forward-looking manufacturers of equipment used by the gas industry are investing their money to help increase the sale of gas and of gas-burning appliances and equipment. These manufacturers know that as the gas industry goes, so goes their business.

The job that needs doing is too big for twelve manufacturers. Every supplier to the industry is invited to share in this business insurance program, under the direction of the Equipment Manufacturers' Advisory Committee of GAMA.

HOW YOU CAN BENEFIT

Mr. Supplier. Help insure your future earnings by investing in this program.

Mr. Utility. Make this program pay extra dividends for you by mailing proofs of these ads to your dealers and running these ads in your newspapers over your company name. FREE reprints and mats are available.

Published as a Service to the Gas Industry by

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JOB THAT NEEDS DOING

Gas GIVES YOU MORE FREE TIME
7 ways Gas makes your home modern as tomorrow
Gas
YES, Gas gives you MORE
GAS is 7 ways better for the 7 big household services
OPERATION HOME IMPROVEMENT

National advertisements like these, designed to increase the sale of gas, are paid for by the following Suppliers to the Gas Industry.

A. C. Lawrence Leather Co.
American Cast Iron Pipe Co.
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Cleveland Trencher Co.
Fisher Governor Co.
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U. S. Pipe & Foundry Co.
Mueller Company
Rockwell Manufacturing Co.
M. B. Skinner Co.
Sprague Meter Co.
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Subsidiary of Neptune Meter Co.

Motor installation. With its 4-wheel drive traction, the Universal 'Jeep' goes anywhere—through mud, sand and fresh fill—to deliver men, tools and equipment to the job. In new construction areas, the 'Jeep's' extra traction is your assurance that installation and service are always on schedule.

Only 4-Wheel-Drive 'Jeep' vehicles fit so many gas service needs!

Trenching. Digging trenches for service lines is a fast, efficient operation with this 'Jeep'-propelled trencher. It digs up to 800 feet per hour and up to 14 inch widths and 6 foot depths—travels speedily between jobs.

Service vehicle. The "go-anywhere" ability of the rugged 4-Wheel-Drive 'Jeep' Truck makes it ideal for transportation—for service installations, repair crews and equipment, on or off the road, in any weather.

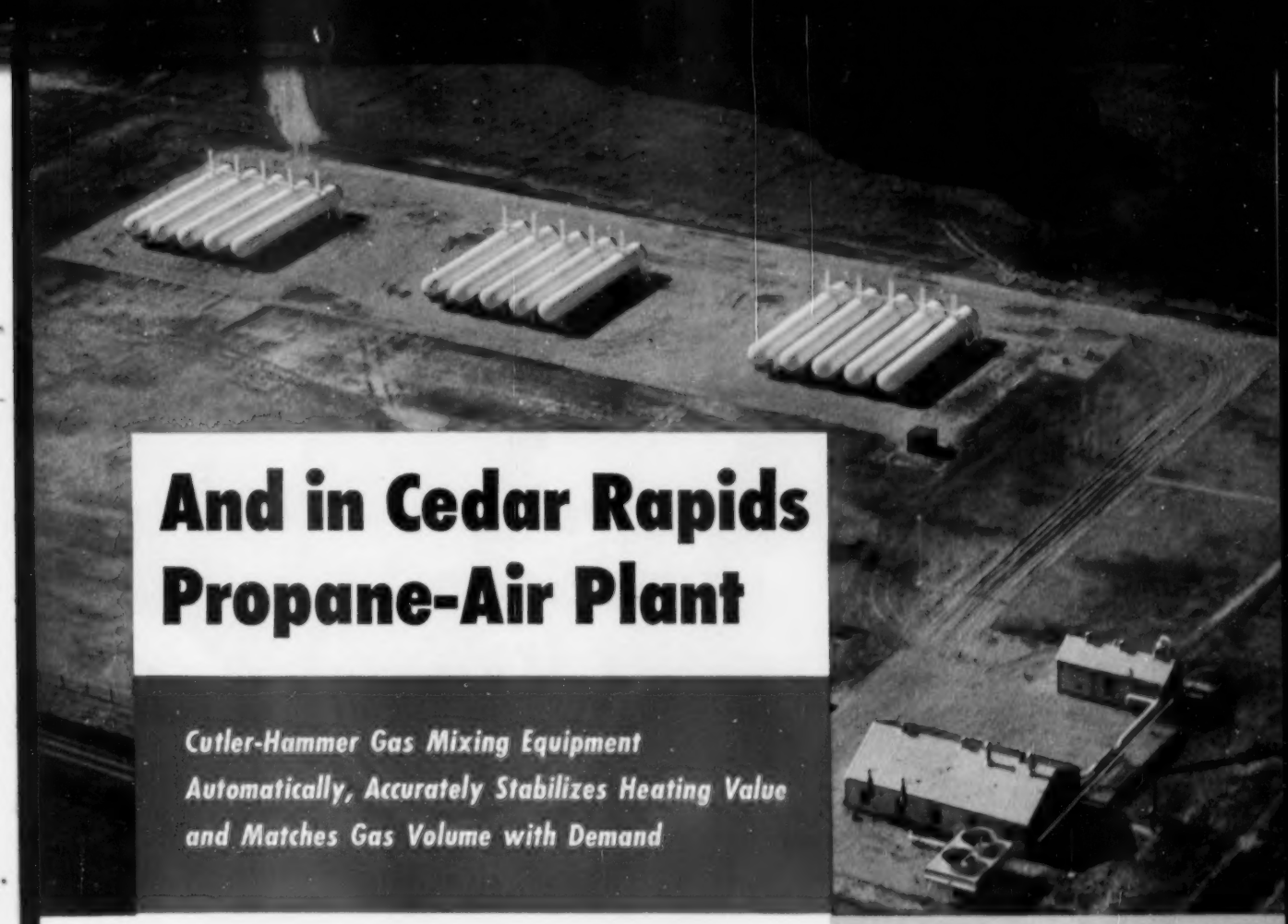
Whether it's following a pipeline cross-country or transporting men and supplies to new construction areas, 'Jeep' 4-Wheel-Drive vehicles are proving their value every day in virtually every phase of the gas industry. With the extra traction of their 4-Wheel-Drive, they go almost anywhere: deliver men, power and tools in emergencies—speed over roads or patrol where there are no roads—through mud, sand, snow or up rocky grades. They shift quickly into conventional 2-wheel drive for travel at highway speeds. And with power take-off they operate welders, compressors, generators and other special equipment. See your Willys dealer for a demonstration, or write for information.

The 'Jeep'®

family of 4-Wheel-Drive vehicles

WILLYS... makers of the world's most useful vehicles

WILLYS MOTORS, INC., TOLEDO 1, OHIO



And in Cedar Rapids Propane-Air Plant

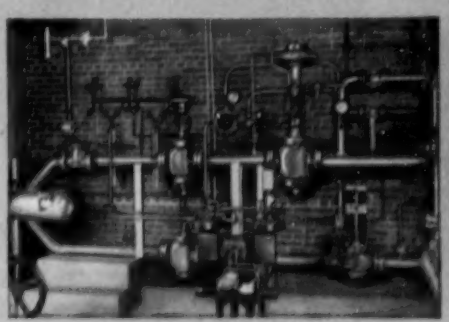
Cutler-Hammer Gas Mixing Equipment Automatically, Accurately Stabilizes Heating Value and Matches Gas Volume with Demand

As the use and distribution of natural gas spread, more and more utilities find it necessary to erect peak-shaving plants to meet unpredictable demands, and to be able to satisfy their good industrial and domestic consumers under any circumstances. The Cedar Rapids plant of the Iowa-Illinois Gas & Electric Co. is an example of the propane-air plant of the type that is the simplest of all to operate.

It is equipped with Cutler-Hammer Gas-Mixing Equipment designed and engineered by Cutler-Hammer engineers to the utility's specific requirements. The Cutler-Hammer Equipment makes operation automatic; heating value and pressure are *always* and automatically stabilized to a pre-set figure; delivery of gas *always* and automatically matches demand. Such C-H equipped plants are *always* ready to supplement the basic gas supply and take over completely in the event of an emergency failure of basic supply. If you want further information about this most efficient and economical of all peak-shaving plants, write or wire at once . . . CUTLER-HAMMER, Inc., 1468 St. Paul Avenue, Milwaukee 1, Wisconsin.

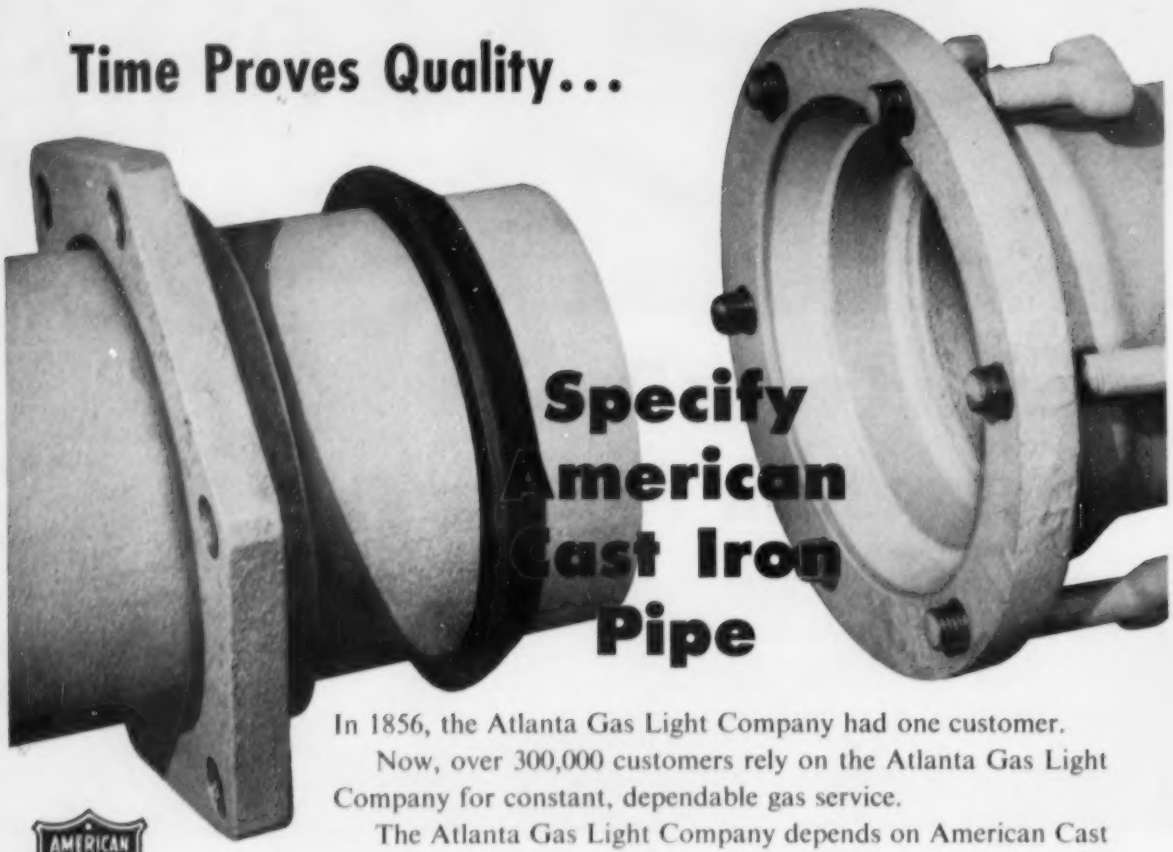
CUTLER-HAMMER
B.t.u. CONTROL
C-H

This is the Cutler-Hammer Calorimeter that measures or "counts" and the Calorimixer that stabilizes the value of the propane-air mixture.



These valves and regulators are automatically and accurately controlled by Cutler-Hammer Gas Mixing Equipment, to match supply with demand.

Time Proves Quality...



Specify American Cast Iron Pipe

In 1856, the Atlanta Gas Light Company had one customer.

Now, over 300,000 customers rely on the Atlanta Gas Light Company for constant, dependable gas service.

The Atlanta Gas Light Company depends on American Cast Iron Pipe to help supply this excellent service. As they say, "a great deal of our requirements for cast iron pipe are secured from the American Cast Iron Pipe Company."

The 100 year old Atlanta Gas Light Company is only one of the many gas, water, and other utilities that have depended on American Cast Iron Pipe for many years. A time-proved record of trouble-free, economical service, characteristic of quality pipe, has been the result.

For additional facts about this stronger, tougher, longer lasting, centrifugally cast pipe, call the experienced American Cast Iron Pipe Company representative near you.

American Double-X Joint Pipe is now serving hundreds of important utilities . . .

This crew and meter wagon served Atlanta Gas Light Company customers in the early 1900's . . .

AMERICAN CAST IRON PIPE CO.
BIRMINGHAM 2, ALABAMA

SALES OFFICES
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Kansas City / Minneapolis
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Just the ticket for those INDUSTRIAL and COMMERCIAL jobs!

ACCURATE!
VERSATILE!
FOOLPROOF!

A compact self-contained economical regulator designed to satisfy 90% of your commercial and light industrial regulator requirements.

For distribution use, it steps up the pressure as the demand increases to deliver gas when you need it.

For safe accurate regulation of large volume commercial or industrial services, use Model 461 as a monitor regulator with Model '1100' as the control regulator. Most of the parts interchange. Both are compact, accurate and versatile.

Bulletin 461 gives complete information.

461-1-56

ACCURATE CP MFG CO DEPENDABLE

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MANUFACTURING COMPANY

Pittsburgh 25, Pennsylvania

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in demand, application and approval

...makes it necessary to build bigger and better production facilities for Naugatuck Kralastic. That's why Naugatuck acquired a 150 acre tract of land in the Baton Rouge, Louisiana, area, and allocated funds to double plant capacity with construction to start immediately.

Your demands for Kralastic rubber-resin, a copolymer blend based on styrene, butadiene and acrylonitrile, is greater than ever before; it's growing day after day, week after week. Though Kralastic is being enthusiastically received for hundreds of applications including wheels, drawer slides, housings, window channels, or wherever toughness and lack of friction are important–chemically resistant pipe and fittings are still the largest single use today.

So, to be sure to have Kralastic® available when you want it, in the quantity you need—many millions of dollars are being spent to increase production and technological advancement.

Start making your plans now for this tough, lightweight, corrosion-resistant plastic. For technical information please write us on your letterhead.

United States Rubber

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BRANCHES: Akron • Boston • Gastonia, N.C. • Chicago • Los Angeles • Memphis • New York • Philadelphia • IN CANADA: Naugatuck Chemicals, Elmira, Ontario
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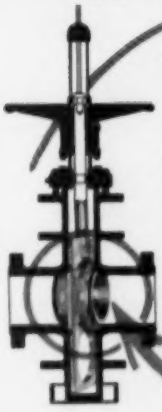
34" full opening high pressure gas line valve—biggest ever built

This Grove Seal-O-Ring Gate Valve with the rugged fabricated steel body design is actuated by a hydraulic piston operating on pressure from the line.



THE WHOLE VALVE IS RIGHT HERE

When valve is full open or closed, bubble-tight seals on both sides of the gate completely isolate line pressure in the conduit. The body, serving merely as framework for operating mechanism and to prevent loss of product while gate is in motion, may be drained or vented to atmosphere when gate is open or closed. Integrity of seals can be checked any time by a tell-tale valve on the body.

602

GROVE SEAL-"O"-RING Gate Valves

GROVE VALVE and REGULATOR COMPANY • 65th & Hollis Sts., Oakland 8, California
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GROVE SEAL-RING GROVE SIMPLICITY ACCURACY SAFETY

BIG INCH OR LITTLE INCH

You get automatic low-cost application when you specify high-quality Polyken

HOW IS THIS POSSIBLE? Factory controlled production from controlled materials—the source of quality—is likewise the source of low-cost field application.

By transferring your coating production *to our plant*, you get:

1. *Polyken* "Controlled Strength"—careful control in the selection and mass processing of raw materials to assure you "all work—no waste";
2. Uniform composition, thickness and adhesion;
3. Application right from the roll—little handling, no heat, no thinners, no solvents, no drying, no cooling, no cleanup time required;
4. High-speed, low-labor power taping for "big inch" as well as "little inch" installations;
5. Lowest equipment investment and manpower costs.

We can't figure your costs here in dollars and cents. But show us your plans—and we suspect you'll be surprised at how little this method costs you.

Let's talk it over now. Write, wire or phone today. The Kendall Company, Polyken Sales Division, Department G-F, 222 West Adams St., Chicago 6, Illinois (Randolph 6-4250).

Complete catalog, Sweet's Industrial Construction File, Sec. 9c

Polyken®

CONTROLLED STRENGTH

PROTECTIVE COATINGS

THE KENDALL CO., POLYKEN SALES DIVISION

BIG CAPACITY— *LITTLE* BULK AND WEIGHT

Cast aside the idea that you need a bulky, heavy meter to handle 415 cfh loads. Cast your eyes on the Rockwell "415". It's housed in a trim, sturdy aluminum alloy case. The entire unit weighs only 19½ lb. One man can easily hold it aloft to install. The bowl type body with single joint construction minimizes leakage risks. To simplify service there's the quickly removable and interchangeable valve plate assembly. For a new appreciation of measurement at its finest, see . . .

The Rockwell "415"

- **FOR APARTMENT HOUSES**
- **SMALL INDUSTRIALS**
- **SCHOOLS, SHOPS, ETC.**

ROCKWELL Aluminum METERS

ROCKWELL "015" Regulators

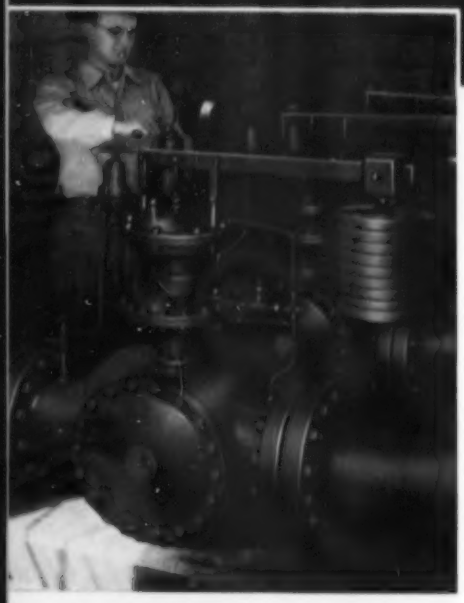
BRING

Precise Control

WITH

Complete Safety

Pilot loaded Rockwell high pressure regulators with auxiliary spring control.



Operator adjusts pilot loading pressure on Rockwell "015" regulator fitted with auxiliary lever and weight control.

DUAL CONTROL SYSTEMS *DO THE TRICK!*

Rockwell *power pilot* regulators are available with two types of built-in auxiliary controls—spring, and lever and weight. In either case the auxiliary system is non-operative when the pilot loader is functioning normally. It takes over automatically should the inlet pressure fall below the setting of the pilot control. For complete safety, the auxiliary system serves to take over the regulating job should the pilot loader become inoperative. Write for bulletin 1086.

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YOU CAN RELY ON ROCKWELL

There's a ROCKWELL METER and REGULATOR for every use

METERS

REGULATORS

Built to "take it," this low-cost Barber-Greene Ditcher cuts the cost of digging narrow trenches . . . proves that hand digging is no longer economical, even on the smallest jobs.

Digging from house to main at less cost than ever before

When laying pipe for service lines and other installations, utilities and contractors have had to contend with the high cost of digging and backfilling the required trenches.

The new Barber-Greene 702 Ditcher has solved this problem. Despite its small size, the 702 is the newest machine in the most rugged line of ditchers made.

Prior to this new development, available machines either dug too wide for practical and economical operation, or did not have the stamina and digability required for coping with unfavorable conditions.

Utilities, contractors and railroads are now gaining the advantages of underground lines and services in virtually every area of the country.

Applications, to date, include electric power and telephone lines and house services, railroad signal systems, traffic control systems, outdoor theater wiring, installations of small gas and water lines and services, lawn sprinkling systems and others.

Digs to 40" deep, 5" wide. The 702 can be easily towed or carried on a light truck. Simple-to-operate dual controls permit operation from seat or from side of machine for full view of trench.

56-30-D

Write for literature on this important, new, low-cost ditcher

Barber-Greene BG

AURORA, ILLINOIS, U.S.A.

CONVEYORS . . . LOADERS . . . DITCHERS . . . ASPHALT PAVING EQUIPMENT

helping
the gas industry
plan for **new peaks ahead**

In addition to supplying an all-time peak demand—in the home and factory—America's gas companies are planning for the even greater capacity that will be needed tomorrow. In this planning, many gas companies have found that Ebasco can be of help. Ebasco's specialized services to the gas industry encompass every aspect of operation—from studies of present and potential markets, production planning, long range system planning, financing, rates, sales—right up through the design and construction of new facilities.

In its half-century of service to the gas industry, Ebasco has worked for clients on every phase of operations. For more information about our services, ask for "The Inside Story of Outside Help." Write: Ebasco Services, Incorporated, Dept. F, Two Rector Street, New York 6, N. Y.

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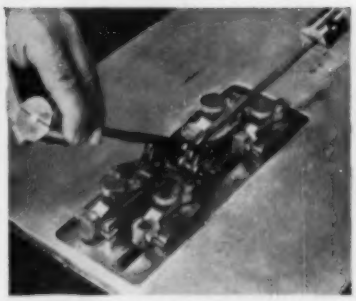
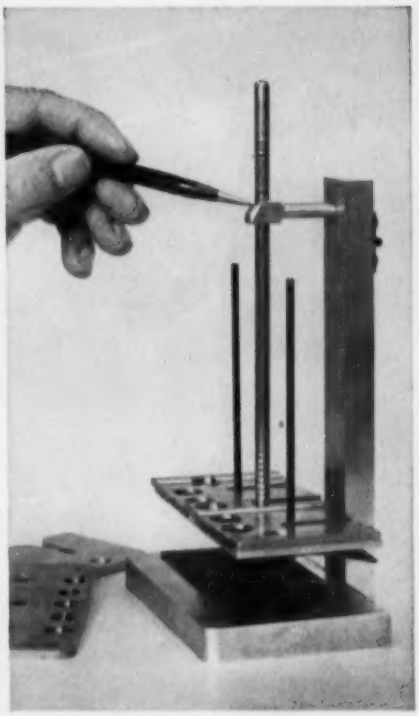
UNIFORMITY of weight and thickness of "Fairprene"* diaphragm material is assured by beta ray testing. Thickness of neoprene coatings is constantly controlled to meet the most exacting requirements.

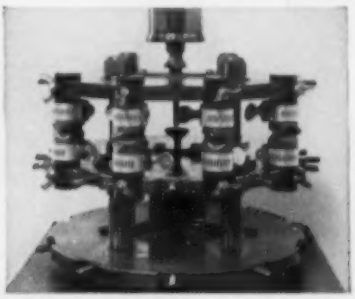


SCRUB RESISTANCE of "Fairprene" diaphragm material is demonstrated by scrub test. Neoprene coating is securely bonded to fabric backing . . . is virtually unaffected by constant flexing and friction.



CONTROLLED SENSITIVITY is measured by "S-Fold Pliability Test." Immersion in oils and aromatic fuels followed by testing at extremes of temperature demonstrates the pliability of diaphragms made of Du Pont "Fairprene."

POROSITY of diaphragms of "Fairprene" to gases is tested by subjecting diaphragms to high air pressure under water. Absence of air bubbles indicates extreme pressures withstood by "Fairprene" coated fabrics.



FLEX RESISTANCE is shown by this flexibility test. Vibrator telescopes years of active service into hours, yet after this rugged treatment "Fairprene" diaphragm material shows no evidence of cracking.

Whatever you need in a diaphragm material ...you'll find in a Du Pont Fairprene® product

Manufacturers of gas meters are taking a close look at Du Pont "Fairprene" coated fabrics as a diaphragm material. And with good reason!

Diaphragms of "Fairprene" show exceptional resistance to the deteriorating effects of all types of gases—natural, manufactured, mixed gases and liquefied petroleum. Lightweight and flexible, these diaphragms withstand years of continuous service—even at extremes of temperature. "Fairprene" also shows exceptional tear strength, burst strength and resistance to loss of coating on exposure to the aromatic components of manufactured gases.

Almost any kind of diaphragm can be manufactured from "Fairprene"—along with hundreds of other industrial products. If you need a special gasket, seal, diaphragm or protective cloth in your plant—or to improve your product—it may pay you to investigate "Fairprene" coated fabrics. Du Pont engineers will gladly work with you in developing special grades of "Fairprene" to meet your own specifications. For further information about diaphragms of Du Pont "Fairprene" just clip and mail the coupon.

*"Fairprene" is Du Pont's trade-mark for coated fabrics, sheet stocks, and cements.

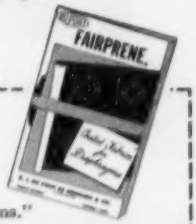
DU PONT INDUSTRIAL COATED FABRICS

E. I. du Pont de Nemours & Company (Inc.)
Fairfield, Conn.

DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING... THROUGH CHEMISTRY

Mail coupon for further information . . .



E. I. du Pont de Nemours & Co. (Inc.)
Fabrics Division, G-66, Fairfield, Conn.

I am interested in "Fairprene" Industrial Products.

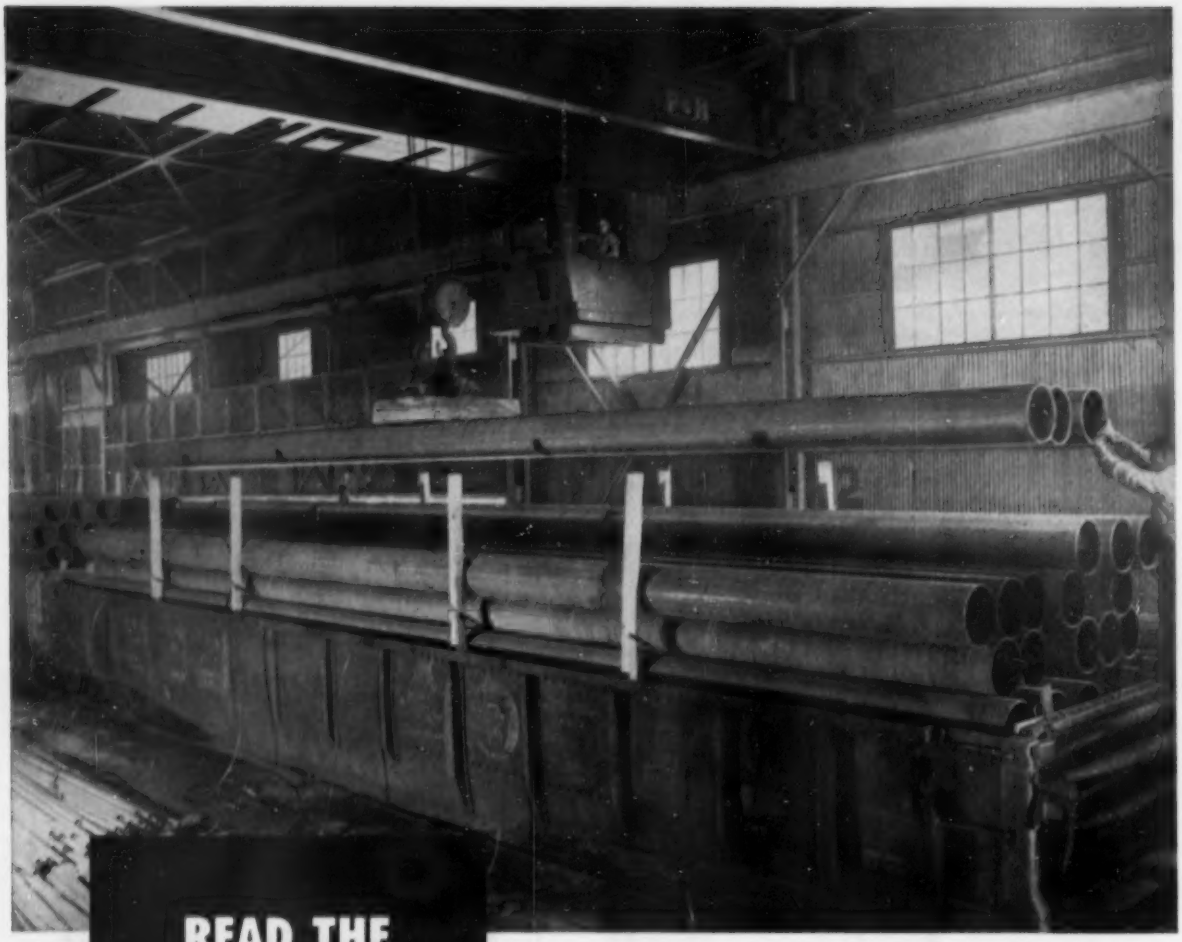
( ) Have a representative call.
( ) Send booklet "Coated Fabrics for Diaphragms."

Name _____ Title _____

Firm _____

Address _____

City _____ State _____



READ THE INSIDE STORY ON PIPE PROTECTION

The great outdoors is no place to coat and wrap pipe. It rains. The weather changes. It's too hot or too cold. It's too wet or it's too dry. That's why the pipe you see above is *indoors*...in a HILL, HUBBELL factory where it will be machine-cleaned, coated and wrapped, under precisely controlled conditions of temperature and processing. HILL, HUBBELL had the know-how to *develop* the factory system of pipe coating and wrapping. Like so many of the forward strides in pipe protection, it is—

Another "first" pioneered by the first name in pipe protection...

HILL, HUBBELL & COMPANY

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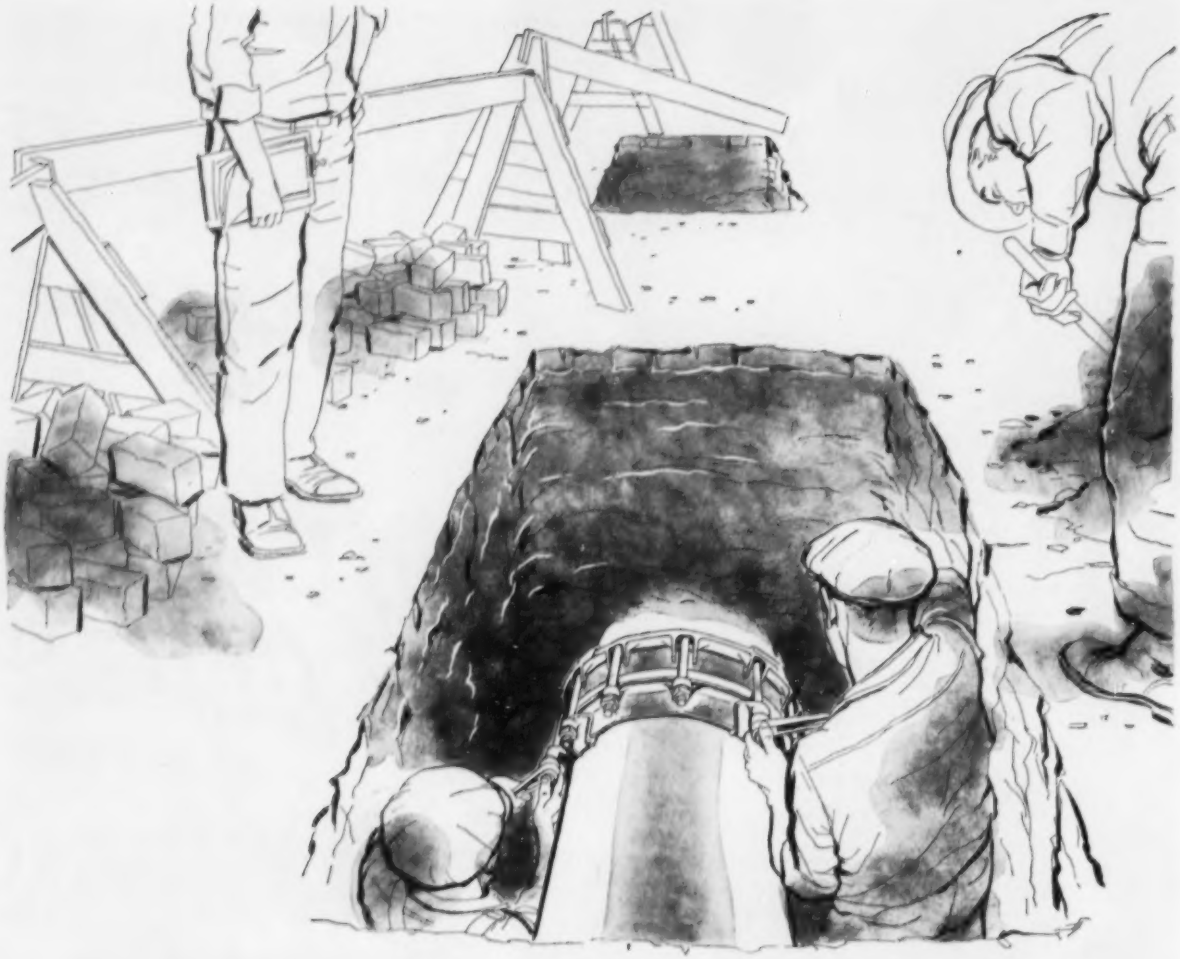
THE CLAMP WITH THE *Sealed Gasket and 3/4" Bolts!*

SKINNER-SEAL Bell Joint Clamps stop bell and spigot joint leaks under pressure. Speedy one-man installation cuts repair costs.

Gasket is completely SEALED and protected; at the bell face by a Monel Metal Seal Band; at the spigot by hard, vulcanized gasket tip, acting as a plug. Equalized pressure forces gasket into every crevice in the joint, sealing the leak at its source. Sturdy malleable iron Compression and Anchor Rings—shaped and pressure-tested before shipping. Large ¾" bolts. Plated or unplated. Malleable iron bolts furnished on special request.

M. B. SKINNER CO.
Est. 1898
SOUTH BEND 21, INDIANA

SKINNER-SEAL BELL JOINT CLAMP



PERMANENCE COSTS SO LITTLE

. . . doing it the Dresser way!

Now you can build new line safety into all old cast iron bell-and-spigot joints . . . quickly and at lowest cost . . . using leakproof Dresser Style 60 Bell Joint Clamps.

Whenever you boost pressures, change over to natural gas, or uncover bell-and-spigot joints for *any* reason, install these Dresser Clamps. They are gastight, have resilient rubber gaskets that absorb pipe movement, vibration and other line stresses *without leakage.* Their strong, balanced construction insures uniform gasket pressure at all points and a joint that stays maintenance-free for life.

A full-color, step-by-step training film which shows the correct way to clamp in all situations is available for gas companies. Contact your local Dresser representative or write us to arrange a showing for your service people.

DRESSER. ONE OF THE DRESSER INDUSTRIES

FITTING PARTNER FOR THE GAS INDUSTRY

Dresser Manufacturing Division, 59 Fisher Ave., Bradford, Pa. Warehouses: 1121 Rothwell St., Houston; 101 S. Airport Blvd., S. San Francisco. Sales Offices also in: New York, Philadelphia, Chicago, Atlanta, Denver. In Canada: Toronto, Calgary.

Here's a trench digger, backfiller, and compacter in one neat package, on a New Jersey water-company job. Truck arrangement provides transportation for men and tools. Compact 25 by 82 in. Le Roi 105 Utility compressor powers Le Roi-Cleveland breakers and tampers. Le Roi-Cleveland triple tamper in foreground features adjustable-height handle bar for greatest operating ease. It can replace five single tampers. Most important, when tamping, it stays close to the ground, making dangerous high lifts unnecessary.

Work-Saving Air-Tool Applications

by LE ROI

Highway construction in Mexico is frequently for the birds, or literally could be as this picture indicates. Two operators pictured on this treacherous perch rely on easy-handling Le Roi-Cleveland sinkers, as do 38 others on job. To complicate the fatigue problem, this area around Chilpancingo is often subject to extreme heat. Sealed dust-proof feature is one reason why these tools produce the powerful, constant rotation needed for fast drilling.

On this $1,600,000 Cleveland sewer job, Le Roi-Cleveland clay diggers set a daily 20-ft. pace. The C-10 clay spade was chosen because a great deal of handling and lifting were required. Operators appreciated a well-balanced tool for this rush job. The spade also is free from bumps, so that operators can get a firm grip and still work close to tunnel walls.

Gas company employee breaks through tough 12-in. concrete. To speed emergency repair work, this utility chose the maximum shattering impact of a Le Roi-Cleveland 52 paving breaker. Work speed, however, was only one consideration. Low-cost operation was important too. The 52's piston air-cushion reduces internal part wear, makes handling easier.

LE ROI Division of Westinghouse Air Brake Co., Milwaukee 1, Wisconsin, manufacturers of Cleveland air tools, Tractair, portable and stationary air compressors, and heavy-duty industrial engines. Write us for information on any of these products.

Lone Star Gas Co. —Cleveland users for over 30 years

More than 30 years ago The Lone Star Gas Company of Texas purchased its first Cleveland Trencher and has been a regular purchaser of Clevelands ever since. Today Lone Star provides natural gas service for approximately 750,000 customers in Dallas and Fort Worth and more than 400 other cities and towns throughout Texas and Oklahoma.

The Cleveland Model 140, shown at right and below on a Lone Star construction project, is digging 2,400 feet of trench for a 6-inch line and 2,000 feet for a 3-inch line in the vicinity of Second Avenue and Catalina, between Dallas and Rylie on U. S. Highway 175.

Cleveland 140 here is digging trench from which tunnel will be bored for a street crossing.

Full crawler mounting, low ground bearing pressure make Clevelands easy on lawns, walks, etc.

Complete operator visibility, easy working controls, help to cut trench exactly where it's wanted.

Talk it over with your Cleveland distributor

THE CLEVELAND TRENCHER COMPANY • 20100 St. Clair Ave., Cleveland 17, Ohio

CLEVELAND®

GAS exclusive

GAS

JUNE 1956

Memomotion study aids utility

Milwaukee Gas Light Co. is using a motion picture camera to conduct a time study of work methods and crew operations in its construction and repair department. Careful analysis of the film has enabled the company to make changes in its operating procedure that have saved them man hours and money. Here's how they do it . . .

By H. A. SCHOPLER, Assistant to the Manager, Distribution, Construction & Repair • Milwaukee (Wis.) Gas Light Co.

THIS is an unprecedented period of expansion and new construction in the history of most utilities. It has, therefore, become of increasing importance to determine optimum operating conditions so that work can be accomplished quickly and economically. Even the slightest time and cost saving on a per unit basis becomes a major item in terms of today's number of units installed.

A simple approach to the analysis of work methods and crew operations is by use of motion pictures.

The word MEM-O-MOTION is derived from the initials of the man who developed this specialized application of micromotion study, Dr. Marvin E. Mundel.*

Micromotion study was originated by Frank B. and Lillian M. Gilbreth. It is a technique for analysis of activities involving the use of a motion picture camera as the medium for obtaining the data. Memomotion is that type of study, but involves taking the pictures at unusually slow speeds (as one frame per second).

*Dr. Mundel is vice-director of the Management Center of the College of Business Administration, Marquette University. A discussion of Memomotion appears in his book, "Motion and Time Study," Prentice-Hall Inc., 1955.

This method is particularly applicable to long-cycle jobs and crew activities because sufficient detail is recorded at minimum cost. Film costs are reduced to about 6% of the costs at normal speed and analysis time is also greatly reduced without sacrificing the recording of any portion of the total job.

Memomotion is, therefore, a tool for work study which permits accurate recording of data for detailed analyses as well as for future reference and comparison.

The equipment used consists of a movie camera (most commonly a 16-mm Kodak, Bell & Howell or Bolex), which is driven by a special synchronous drive mechanism instead of the camera's spring-activated drive. One of the latest synchronous drive units, designed by Dr. Mundel, can be geared to:

60 frames/min.; exposure ⅛ sec.
100 frames/min.; exposure 1/12 sec.
1000 frames/min.; exposure 1/30 sec. (normal silent speed)

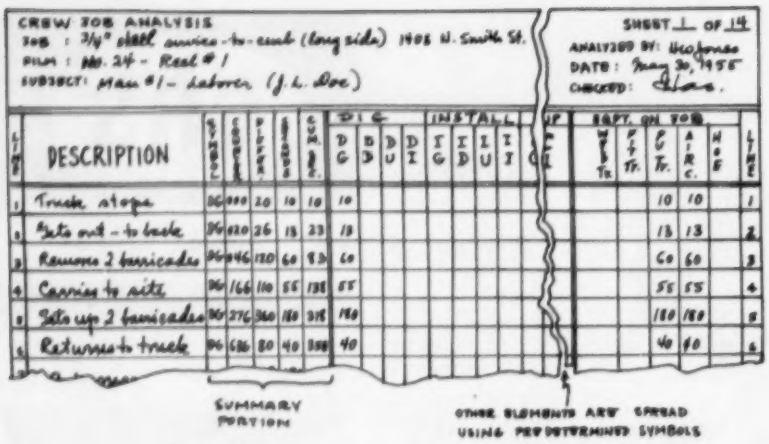

CREW JOB ANALYSIS
JOB : 3/4" steel service-to-curb (long side) 1905 N. Smith St.
FILM : No. 24 - Reel # 1
SUBJECT: Man #1 - laborer (J. L. Doe)
SHEET 1 OF 14
ANALYZED BY: Hoffman
DATE : May 30, 1955
CHECKED:
DESCRIPTION
INSTALL
DEPT. ON JOB
Truck stops
Gets out - to back
Removes 2 barricades
Carries to site
Sets up 2 barricades
Returns to truck
SUMMARY PORTION
OTHER ELEMENTS ARE SPREAD USING PREDETERMINED SYMBOLS

Fig. 1. Data sheets for a new service to curb installation.

1400 frames/min.; exposure 1/45 sec. (sound speed)

The camera is usually equipped with a wide-angle lens (f 1.5, 13mm, for example) to permit observance of a crew operation. Finally, an analysis projector is required. Such a projector has been used for some time in micromotion studies. It has an automatic indexer (single frame control), frame counter and heat filter.

Obviously, the cost of this equipment will vary with brand and model, but the approximate cost of a camera; synchronous drive; lens; tripod; exposure meter; re-wind, editing and splicing equipment; carrying case and projector would be $1500 (list).

The two big items of controllable cost on a construction and repair job are labor and equipment costs. It is assumed that the material requirements are fixed by the job and that backfill and pavement repairs are effected in accordance with engineering specifications and municipal regulations.

Memomotion should, therefore, help in the determination of:

1. How many men should work on the job?
2. How should the work be divided?
3. What machines should be used on the job?
4. When and how long should these machines be on the job?
5. How should the jobs be planned, laid out and scheduled?

There are two obvious extremes of high unit cost—very few men with no equipment and too many men with too much equipment. The curve connecting these extremes must have a minimum. Memomotion is an effective tool for the practical determination of this minimum unit cost.

Memomotion study preparation

As in any study, the method of sampling is of prime importance in obtaining accurate and reliable results. It is necessary, therefore, to obtain the cooperation of the crew by explaining what is being done, to select a rather typical job and to film the action when the crew is working at its normal rate.

Cooperation is readily obtained because it is human nature to enjoy "starring" in a movie. The crew should be permitted to see the completed film, which when projected at normal film speed, will appear to be a rapid motion comedy like the old "Keystone Cops."

The job selection depends on an understanding of "average" conditions. It is usually a good idea to make a first study by filming and analyzing a difficult job. It is then not likely that the recommendations are contested on the grounds that "anyone can plan out a simple job like that one." For example, a service renewal study should be started with a film of a long-side renewal, under a paved street. If additional hazards are desired, a winter job on a busy thoroughfare can be selected.

After the obvious improvements have been made, it will be necessary to film several similar jobs with different crews and different physical conditions so that details of optimum procedure can be determined.

In order to avoid the crew's working at an unusual rate, it may sometimes be necessary to film several successive jobs. The first few times, there need be no film in the camera, but this fact need not be advertised.

When filming the job, it is important to locate the camera so that the entire scope of the crew's operation is seen by the wide-angle lens. Of course, the camera can be moved, but it is important that none of the action is lost during the move or the scanning (see illustration on page 43).

Notes should be kept with the following data as a *minimum* requirement:

1. Location and date of job.
2. Starting time of the job.
3. Starting and stopping time of each reel or magazine and proper identification.
4. Identification of each crew member (numbered jerseys or hats are helpful).
5. Time of each change of camera location, and reason for change.
6. Brief description of sequence of events.
7. Notes of all unusual events such as lunch breaks, bad weather breaks, equipment trouble, etc.
8. Completion time for the job.

Table 1 shows approximately how long the camera can be run without changing film.* This is important, as the crew must stop work for several minutes while film changes are made.

The tabulation shows the film cost reduction to about 6% of the normal speed costs.

How is the film analyzed

After a brief edit and review, unnecessary leaders and superfluous film are removed and reels may be labelled and spliced together. It is essential that none of the actual job record is lost.

TABLE 1. LENGTH OF CAMERA RUN

Magazine	Film Speed	Continuous Run
100 ft	60 frames/min.	65 minutes
	1000 frames/min.	4 minutes
200 ft	60 frames/min.	130 minutes
	1000 frames/min.	8 minutes

*The table can be extended by using the constant 4000 frames per 100 ft of film. Then, magazine ft × 4000 ÷ frames per min. = run minutes.

The first frame and last frame to be considered as a part of the job are identified on each reel by an ink mark or a punch hole. This is to insure uniformity of results during the subsequent studies.

Each reel is then studied several times. Each frame is viewed separately and each crew member's activities are carefully traced. Since the projector has a frame counter, a frame reading is noted for each change of action. These frame readings can later be related to time increments. With the aid of the notes, these data can be translated into actual time, if necessary.

Some analysis projectors read 2 counts per frame to permit interpolation without fractions. If this is true, the count must be halved before the time factor can be applied.

How are the data recorded

The detailed breakdown of activities for purposes of micromotion study was first described by Frank B. and Lillian M. Gilbreth. These elements were termed THERBLIGS (Gilbreth spelled backwards).

The 17 therbligs are categorized as follows:

A. *Terminal therbligs*	*(Symbol)*
1. Grasp	G
2. Position	P
3. Pre-position	PP
4. Use	U
5. Assemble	A
6. Disassemble	DA
7. Release load	RL
B. *Gross movement therbligs*	
8. Transport empty	TE
9. Transport loaded	TL
C. *Hesitant movement therbligs*	
10. Search	SH
11. Select	ST
D. *Delay therbligs*	
12. Hold	H
13. Unavoidable delay	UD
14. Avoidable delay	AD
15. Rest (overcome fatigue)	R
E. *Think therbligs*	
16. Plan	PN
17. Inspect	I

Memomotion... It is necessary that the desired results and the specific job are clearly understood

For purposes of crew activity analyses in gas utilities, it is necessary to revise these elements to best fit the needs of the individual study.

The elements for the initial analysis of a new service installation may be categorized as shown in *Table 2.* (Examples of each element are given in parenthesis.)

In this example, whenever a man assists others so that he can then do his own job, it is considered *unavoidable delay.* Hence, if the laborer assists the power loader operator in picking up excess spoil, he does so in order to be able to do his regular job of sweeping up the excess dirt but is not *doing* his own work.

In addition to the work elements, it may be desirable to add equipment and tools needed as parts of the analysis.

It is now readily seen that in order to decide on the proper breakdown, it is necessary that the desired results as well as the specific job are clearly understood. Therefore, some job knowledge is essential. For example, if optimum manpower requirements by *classes of work* are desired, the important breakdowns are: Work with machines, work with power tools, work with hand tools, work without tools (plan, layout or direct), necessary delay and idleness. If, on the other hand, the *minimizing of movement* for an otherwise correctly assigned crew is the desired result, the important breakdowns are: Move to, move with, work, necessary delay and idleness. This may prove that there is little delay or idleness which is obvious to the casual ob-

TABLE 2. ELEMENTS FOR INITIAL ANALYSIS

A. Dig Elements	Symbol
1. *Get ready* to do own work (laborer sets up barricades; compressor operator connects hose to hammer)	DG
2. *Do own work* (laborer digs behind curb with shovel; compressor operator cuts street with air tool)	DD
3. *Unavoidable delay* (laborer stands by as compressor operator loosens more frozen ground)	DU
4. *Idleness*—unnecessary (laborer chats with a passer-by regarding frost conditions)	DI
B. Install (or Fit) Elements	
1. *Get ready* to do own work (fitter carries fittings to excavation)	IG
2. *Do own work* (fitter or welder installs tee at main)	ID
3. *Unavoidable delay* (laborer stands by fire extinguisher on top of main excavation while main is tapped)	IU
4. *Idleness*—unnecessary (welder waits while pipe is being laid in place)	II
C. Backfill Elements	
1. *Get ready* to do own work (start engine and position bulldozer)	BG
2. *Do own work* (compressor operator tamps ground in back-of-curb trench)	BD
3. *Unavoidable delay* (laborer waits while truck dumps gravel into street excavation)	BU
4. *Idleness*—unnecessary (fitter watches while laborer flushes trench)	BI
D. Clean-up Elements	
1. *Get ready* to do own work (fitter climbs out of excavation)	CG
2. *Do own work* (fitter returns tools to truck; laborer sweeps road and walk)	CD
3. *Unavoidable delay* (fitter sits in truck until laborer loads last barricade)	CU
4. *Idleness*—unnecessary (fitter and laborer read over orders for next few jobs before starting truck engine)	CI

Memomotion ... The final step requires a trained analyst to interpret the results of the study

server, but that due to improper job planning and layout, the men are moving to and from the supply wagon more than they are working productively.

The data sheets for a new service to curb installation might appear as shown in *Fig. 1*.

It is observed from the data sheet that the counter reading recorded is for the *start* of the element described, hence the difference (which is indicative of the time interval) is the number of counts until the next element starts. The projector used for this analysis counted 2 for every frame, hence the "seconds" are half the "difference" readings.

The times determined in the summary portion of the data sheet are then spread into the detail portions by element symbols. Totals are obtained to show by classifications of workers and by work equipment the total time required for digging, installing, backfilling and cleaning up. In each category, totals are obtained to show the time for getting ready, doing, unavoidable delay and idleness.

How are the data analyzed

From the individual summaries, a composite crew activity chart is prepared. This is usually a graph showing the arrival, activity, idleness and departure time of each worker and each piece of transportation and mechanical equipment. A sample analysis chart is shown in *Fig. 2*.

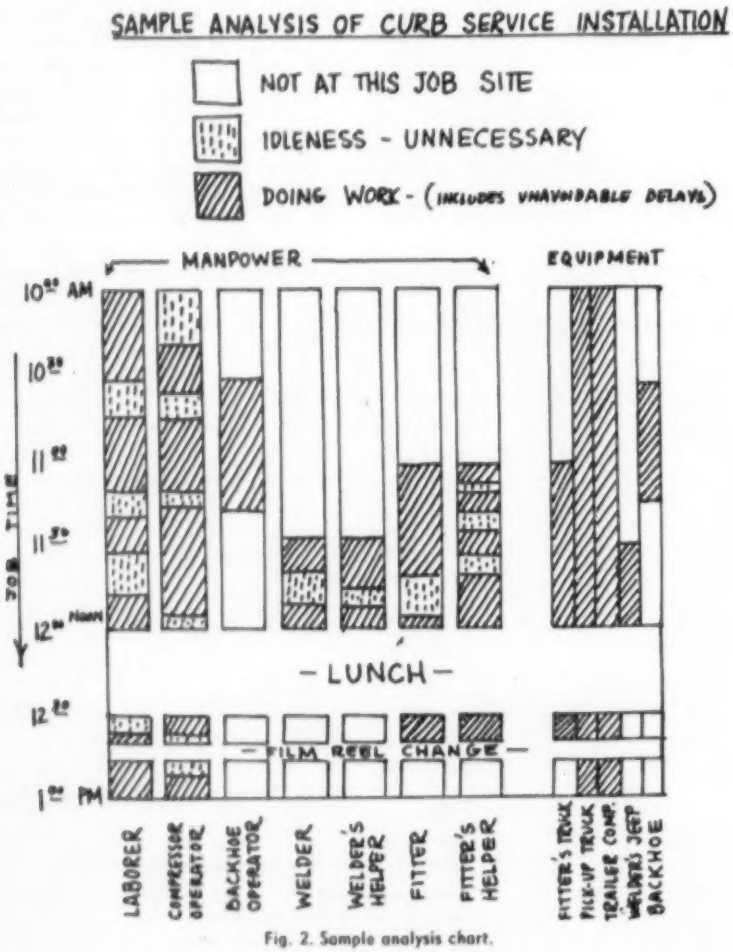


Fig. 2. Sample analysis chart.

The following facts are available to the analyst when the various summaries are reviewed:

(1) The entire installation required from 10 a.m. until 1 p.m. Considering film reel change and lunch, this represents 2 hours and 25 minutes.

(2) The man-hour requirements were:

Laborer	2 hr 25 min.
Compressor operator	2 hr 25 min.
Backhoe operator	20 min.
Welder	30 min.
Welder's helper	30 min.
Fitter	1 hr 10 min.
Fitter's helper	1 hr 10 min.
TOTAL	8 hr 30 min.

Since the foreman visited the job twice for 15 minutes, 30 minutes are added to obtain *9.0 man-hours for the job*.

(3) The equipment requirements were:

Pick-up truck	2 hr 25 min.
Fitter's truck	1 hr 10 min.
Foreman's car	30 min.
TRANSPORTATION	4 hr 5 min.
Trailer compressor	2 hr 20 min.
Welder's jeep	30 min.
Backhoe	20 min.
WORK EQUIPMENT	3 hr 10 min.

The job is charged with *4.08 hours* of transportation equipment plus *3.17 hours* of work equipment. The percentage of idle time for men and equipment can be obtained if the results indicate this to be necessary.

(4) The following functional breakdown is observed:

	(Time)
Dig elements	38.57%
Install elements	54.29%
Backfill elements	3.99%
Clean-up elements	3.15%
	100.00%

A review of the data sheet totals will also yield *the percentage of get ready, do, delay and idleness by elements or in total.*

Conclusions drawn from these facts

The final step in the Memomotion procedure is the most difficult. It requires a trained analyst to properly interpret the results of the study.

The conclusions will undoubtedly vary from company to company even if the film shows the basic facts to be the same. This is true for many reasons, but perhaps the most important one is the concentration or geographic spread of the jobs and the number of these jobs. A utility with few and widespread jobs needs crews with all-purpose equipment and an average complement, whereas a utility with many, closely grouped jobs can specialize functionally to obtain mass production advantages.

A few considerations for the Memomotion analyst follow:

(1) *There are two basic methods of departmental operation.* One method involves all-purpose crews which will do any kind of job. The other method involves specialized crews which are manned and equipped for a specific job and will repeat this job on a mass production basis. Advantages and disadvantages are readily seen and most large systems can advantageously use both operating arrangements to some extent. Obviously, the second method requires more refined scheduling and routing procedures.

(2) *There are two basic methods of crew operation.* One method involves several men with an all-purpose machine to carry out a job from street cut to clean-up. The other method involves a small group of pavement cutters, a group of excavators, a group of fitters and a group of backfillers. The groups are properly balanced to maintain a constant flow of production. The first method has the advantages of greater versatility and interchangeability, while the latter method has the advantages of specialization of men and machines without the inefficiency due to lost time.

(3) *Specialized equipment is frequently better than an all-purpose machine.* Service excavations, for example, can be dug with small trenchers or with medium-size backhoes, but clamp holes are best dug with a backhoe; the small cuts for copper or plastic service renewals can best be made with a small backhoe, while a large hoe, crane or trencher is required for most main trenching. It must also be considered that a combination backhoe-compressor-backfiller, for example, can only be used for one of its three purposes at a time. Is it economically feasible to have a backhoe idle on the job about 90% of the time, while various other functions are being performed with its engine? The answer could be "yes" only if there are very few jobs with large separating distances.

(4) *Travel time between jobs must be considered and the assignment of crews can have an important influence on the over-all job costs because of this fact.* Larger companies find it advantageous to operate in districts in order to minimize travel. It is, however, important to keep in mind that decentralization should not become a rule without carefully considering the costs of duplication.

Certain functions such as ground pick-up, pavement repair, machine repair or scheduling and routing could cost appreciably more when decentralized if less men and equipment, under centralized operation, can service the entire area effectively.

Approximate costs for equipment used in memomotion study by Milwaukee Gas Light Co.

	Minimum	Maximum
Camera	$280	$ 900
Synchronous drive	250	590
Lens	—	90
Tripod	—	50
Exposure meter	—	30
Splicer-editor	50	90
Projector	250	500
	$830	$2250

Summary and conclusion

When the obvious improvements have been made, as the result of a first try with Memomotion, some more detailed refinements can be studied. A few of these refinements which have been put into effect or which are being put into effect at the Milwaukee Gas Light Co. include:

(1) The calculation of equivalent work units to permit comparison of crew operations and productivity without regard to which of the many types of construction, maintenance or repair jobs the various crews perform.

(2) The separation of non-controllable costs and controllable costs to permit simple variable unit cost comparisons which create a cost consciousness on the foreman level.

(3) The separation of fixed costs, direct costs and overhead costs to obtain economic bases for replacement policies and to supply data for accurate budgeting.

(4) The analysis of basic unit costs for each type of installation to yield comparative cost studies and operating effectiveness for middle and top management.

(5) The calculation of man-hour requirements for various types of work to permit scientific work loading and scheduling.

There are many by-products of a Memomotion study. The original intent may be simply to determine how many men should be assigned to a specific job, but there can be dozens of other studies taken from this set of basic information.

As in all studies, a "before and after" report will show what has been achieved. If the results show that a unit cost reduction of only 10% can be accomplished by some rearrangement, it will represent a large total annual saving. In many specific studies, savings of over 20% have been effected in utility studies and even greater savings in many studies made in other industries.

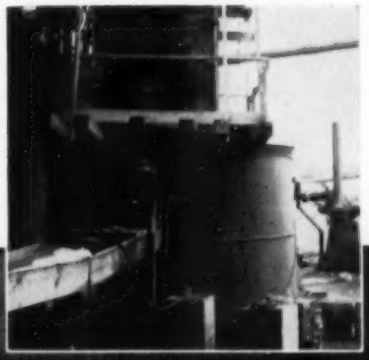
Memomotion has been used to analyze the daily activity of a drug store manager, the cleaning routine of a hotel maid, the light bulb replacement schedule of a hotel maintenance crew, the coordination of a hospital surgical team during an operation, the loading of a commercial airliner and many other situations where minute details of motion requiring less than a second are not major factors.

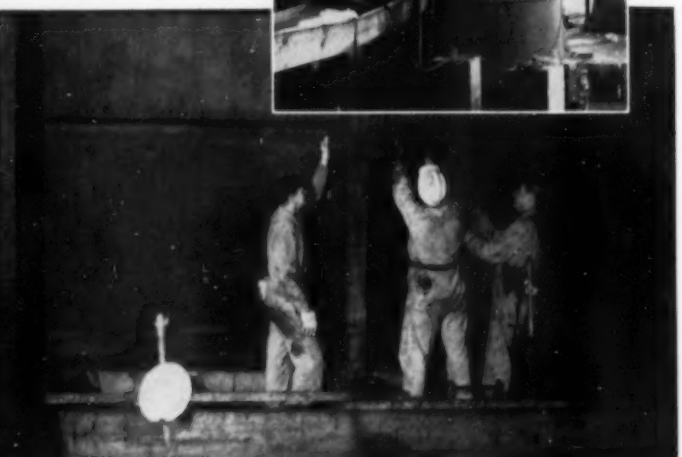
In gas utility studies, Memomotion finds its most important application in the analysis of crew activities to determine the operating method which minimizes idle time and obtains maximum effectiveness from both men and machines. ■

Manufacturing department takes apart the No. 1 holder at Newton station for extensive cleaning and repairing.

Clean-up time at Brooklyn Union

When the gas supply was cut off by disconnecting the 36-in. pipes that feed gas into the 10-MMcf holder, the holder distribution section took over and purged the holder of gas by displacement with inert gases. A 100-ft canvas "sock" took the gas high up into the atmosphere (above). After the holder was ventilated, an elaborate layout (inset at right) was set up to get rid of the water in the tank. More than 17 million gal. were pumped through a wooden tower containing baffles or splash plates. The water flowed from the tower to a settling tank (center) where it was treated with chlorine or sodium hypochlorite to remove traces of odor. After treatment, the water poured through a flume (left foreground) into the sewer. Dewatering was completed in 19 days.

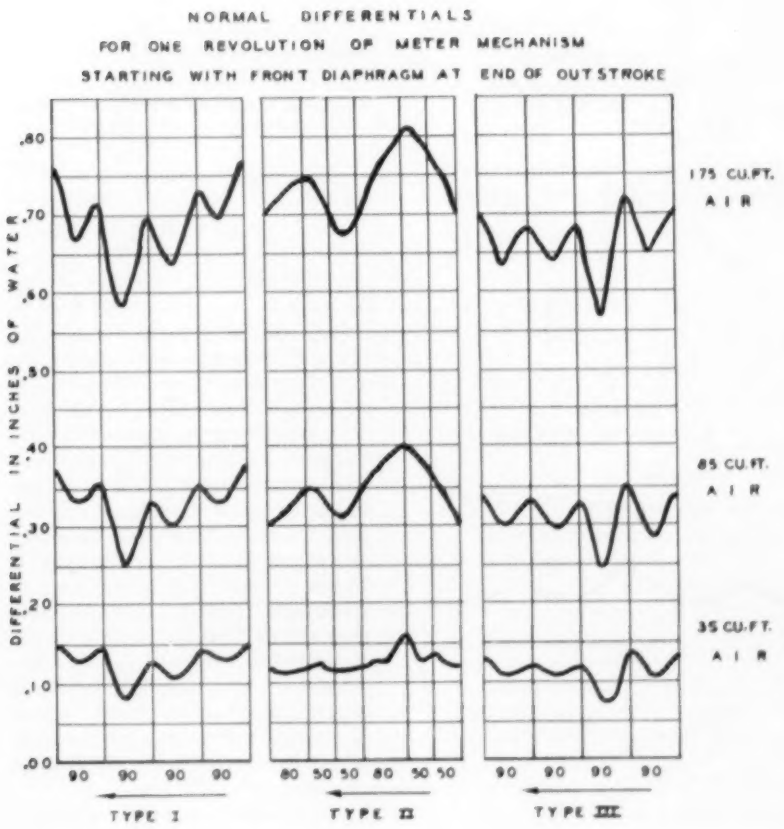




During the dewatered period, and after 100 tons of muck had been taken out, holder distribution was only approaching the job, which was a thorough inspection of the holder and completion of all repairs found necessary. In general, the 45-year-old holder was found to be in good condition. But repairs were made and here (above left) a crewman climbs through a manhole to do a job. With major repairs completed, water was put back. Since the holder was raised with air, crews made repairs to internal rollers from boots (right).

How to check meter performance with a differential gauge

A displacement gas meter can be operating improperly even though it is in correct proof. A differential gauge, used properly, can spot the meters that are in need of repairs. This article tells how meters can be accurately checked.



By ED R. GILMORE
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A DISPLACEMENT gas meter can be in correct proof at both capacity and check rates of flow even though it is operating improperly. Determining the mechanical condition of a meter is just as important as determining the proof. The mechanical condition can be satisfactorily checked by the use of a draft gauge.

A draft gauge is a manometer with an inclined tube which gives increased scale length and permits accurate readings in fractional inches of water. In meter work such a gauge is referred to as a differential gauge because one opening is connected to the pipe leading to the inlet connection of the me-

Fig. 1. Gas meter performance checked with differential gauge.

Differential gauge... Pressure loss is caused by friction

ter and the other is connected to the pipe leading from the outlet connection of the meter. Under these conditions the gauge actually registers the difference, or differential, between the pressure on the inlet and outlet when gas is passing through the meter. This differential is the loss in pressure through the meter.

Friction

Pressure loss is caused by friction, which, for simple explanation, can be separated into two classes:

1. Friction existing in the mechanism of the meter
2. Friction of the gas passing through the valves and channels of the meter.

The loss due to overcoming the friction of the measuring mechanism is the major loss at low rates of flow. The differential required to start the meter can be considered to be entirely caused by the friction of the mechanism. At the higher rates, the flow loss dwarfs the mechanism loss to such an extent that the differential readings at high rates of flow are of reduced value in determining the mechanical condition of small domestic meters. Studies of the differentials at higher rates can be used to advantage in checking for channel stoppages and poor valve and diaphragm coordination.

Observation

The differential at the check rate of flow (one-fifth of the rated capacity) is very satisfactory for observation to determine the mechanical condition of the meter. Any flow rate below one-third the capacity rating can be satisfactorily used for this purpoes.

In observing the differential the maximum and minimum readings should be noted. The rate and magnitude of the pulsations give the best indication of the meter's performance.

The friction in the meter mechanism can be separated into four general classes:

1. Friction at bearing points and valve surfaces.
2. Friction at stuffing box packings.
   Stuffing box packing friction has been separated from bearing point friction because a stuffing box should never be used for a bearing.
3. Friction of the diaphragm material.
4. Friction caused by the unbalanced condition of the meter such as:
   a. Improper division of the diaphragm stroke
   b. Mis-matched diaphragms as to weight and stiffness
   c. Excessive loss motion due to wear or mis-fit bearings
   d. Improper valve setting
   e. Improper valve timing
   f. Improper location of parts about the center of rotation.

Any of these items cause poor coordination of the valves and diaphragms, as to adjustments made when proving the meter to compensate for errors that have been built into the device.

Uniform drag

Items 1, 2 and 3 have a tendency to place a more uniform drag on the meter, which causes a higher overall differential. This is especially true of stuffing box and diaphragm friction. It is, therefore, hard to tell from the reading on the gauge which one is causing the higher differential. If the differential is caused by stuffing boxes, it is very detrimental because such friction will decrease as the meter is used in service. This causes the meter to become fast in proof. Therefore, it is advisable to use diaphragms which do not cause excess friction so that stuffing box drag is more easily detected and segregated. Any uniform friction causing excess differential also will tend to reduce the pulsations due to meter unbalance and other causes. A meter with a higher than normal differential, even though it is uniform, is very likely to be in poor condition.

Friction at bearing points due to mis-

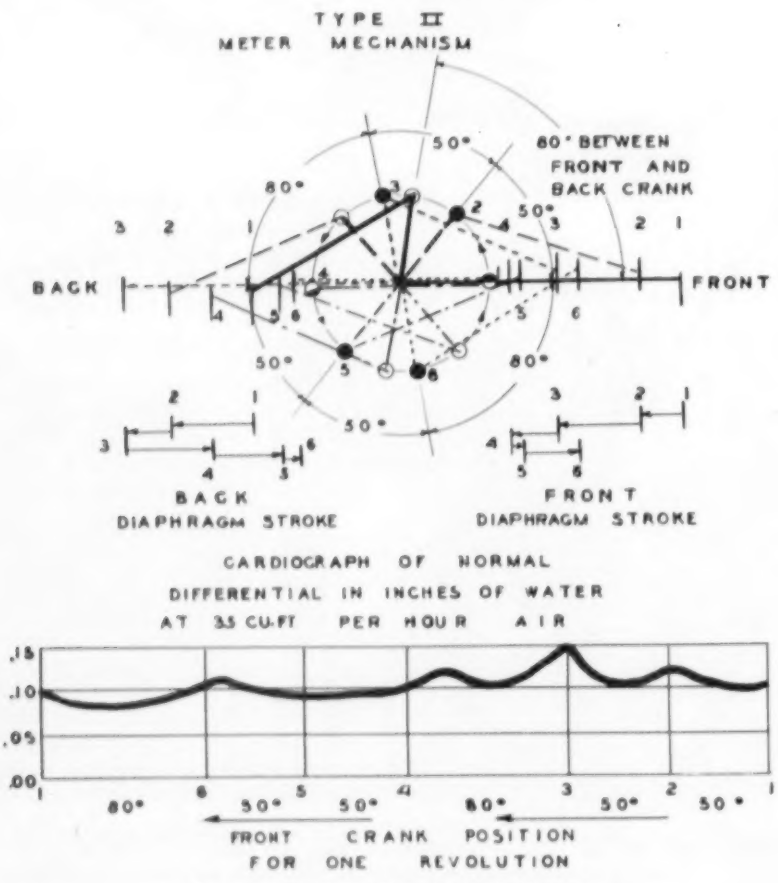

Fig. 2. Characteristic differential of Type II meter.

alignment causes pulsations similar to the troubles listed under Item 4.

Each make and size of meter has a typical, normal magnitude, frequency and rapidity of pulsation as disclosed by the differential gauge. The observer must be aware of the normal pulsations for the meter being tested to expertly pass or reject a meter for mechanical performance.

The recorded differential as produced by the cardiograph is very helpful in learning how to interpret the differential gauge readings. *Fig. 1* shows typical graphs of the differential for three types of meters. Any mechanical defect in the meter mechanism will cause a noticeable variation from these graphs.

Design and operation

Fig. 2 shows how the characteristic differential of the Type II meter ties in with the design and operation of the mechanism. From a study of this diagram the most critical points in the cycle of the meter are readily determined. Excess friction occurring at these intervals anywhere in the mechanism will become very noticeable by the magnitude of the differential.

A study of *Fig. 3*, which shows a diagram of the mechanism and differential of the Type III meter, will help explain why these pulsations are characteristic of this type meter.

Both of these studies show that the meter mechanism design determines the normal differential. Any departure from the basic design due to improper alignment, wear, or excess friction, will be directly reflected in the differential produced by the meter being checked for performance.

Before the advent of the newer high capacity domestic meters, with larger valves and larger channels, one average overall differential and one pulsation maximum-and-minimum limit could be used as a standard for all domestic meters in the 165-cu ft per hour capacity bracket. This standard was slightly higher than necessary for some makes and vintages, but satisfactory in all cases for the average meter shop operation. Many shops used a 0.25-in. maximum allowing pulsations from 0.20 in. to 0.25 in. at the 50-cu ft per hour rate of flow.

It would be possible to reduce these limits to 0.15 in. and 0.20 in. if all makes, types and vintages did not have to be considered. It is practical and economical to set standards of 0.20-in. average with a maximum of 0.22 in. and a minimum of 0.18 in. when the best present-day production diaphragm, linkages, bearings and stuffing box packings are used on all meters. If the standards are set up for individual type, meters as low as 0.15 in. and 0.10 in. can easily be maintained at a reasonable cost. If a 35-cu ft per hour rate is used the overall standard may be reduced as well as the maximum and minimum.

Draft gauges are calibrated to read in inches of water. However, this does not mean that water must or can be used in the gauge.

Draft gauge fluids

There are many fluids for which gauges are calibrated in inches of water. Three of these are:

1. Water: Specific gravity 1.00

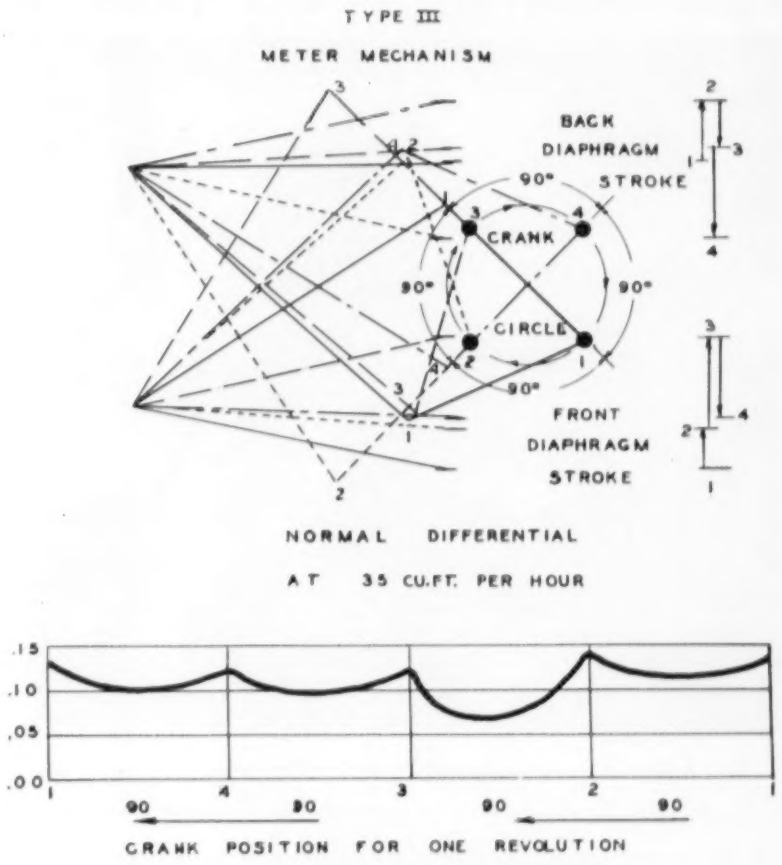

Fig. 3. Characteristic differential of Type III meter.

Draft gauges

There are many types and makes of draft gauges. Some are more sensitive than others. The more sensitive ones show more pulsation than the sluggish ones. Excessive pulsation of a gauge is sometimes dampened by an orifice in the fluid line where it leaves the well. The steady readings of any type or make of draft gauge, if properly calibrated, can be accurately compared with another make or type. The fluctuations cannot be accurately compared.

2. Oil (usually green): Specific gravity 1.00

3. Oil (usually red): Specific gravity .827

All red oils do not have the same specific gravity. Be sure that the specific gravity of the oil or fluid which is used in the gauge is that for which the gauge was designed and calibrated.

Various fluids have different surface tension, which affects the sensitivity of the gauge. The specific gravity of the fluid also affects the sensitivity. Any

Differential gauge... Proper use of the gauge will improve efficiency of any meter shop

change in specific gravity due to excessive temperature changes affects both calibration and sensitivity. Change in the surface tension due to the tube or fluid becoming dirty affects the sensitivity. These facts are mentioned, not that they have any major effect on the gauge as it will be used, but to help the user to be aware that small discrepancies of 0.01 in. may exist in comparing readings of different gauges or making readings with the same gauge under slightly different atmospheric conditions.

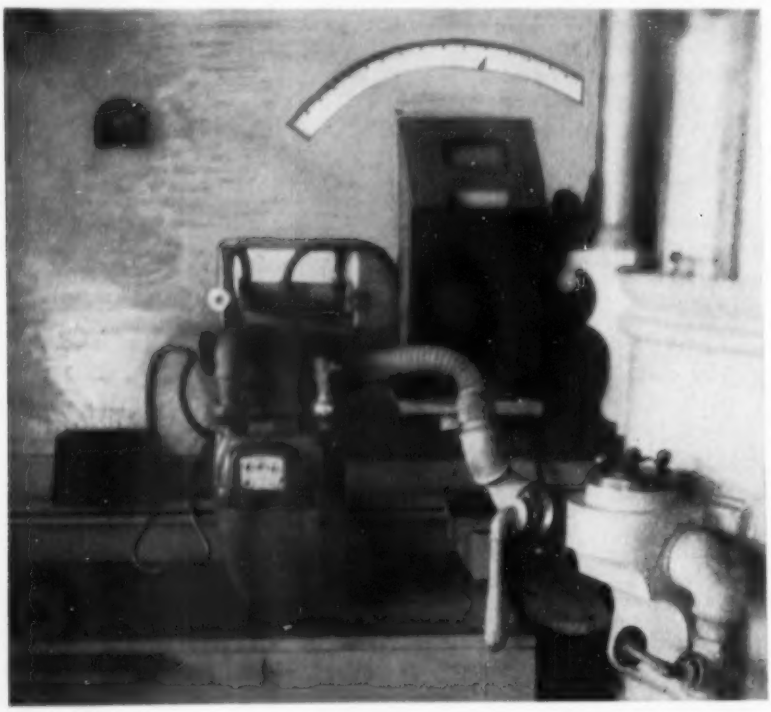

Fig. 4. A meter analyzer instrument board, showing differential gauge connected to meter.

Draft gauge calibration

Draft gauges should have a 2-in. overall range or a 1-in. range if the gauge is equipped with a 2-in. built-in seal, to keep the fluid from blowing at the higher rates of flow.

The scale may be calibrated in 0.01-in. or 0.02-in. graduations, so that it is easily read to 0.01 in. The meter, prover and draft gauge tolerances can be considered sufficiently close for comparable plus or minus 0.01-in. readings.

All draft gauges are equipped with levels and should be securely mounted to maintain a level position.

Zeroing of draft gauge

Zeroing of the draft gauge should be done with both inlet and outlet open to the atmosphere. If the hoses are not disconnected from the gauge the open ends should be at the same level.

Always read the gauge by sighting across the bottom of the menicus.

Analyzer board

Fig. 4, a drawing of a meter analyzer instrument board, shows a draft gauge connected directly behind the meter. This gauge is connected to the inlet and outlet meter swivels by rubber tubing. The cardiograph, mounted directly under the magnified prover scale which can be read to five thousandths of a cubic foot, is connected to the outlet of the meter. The pressure unit of the cardiograph records the outlet pressure. The zero line on the cardiograph scale is the inlet pressure as previously established by the pressure unit. The differential across the meter is the distance between the chart zero, or inlet pressure, and the line drawn by the pen.

The graphs shown in *Fig. 1* were made by this instrument using meters which were in good mechanical condition and accurate proof.

Installation of gauge

The upper-end opening of the inclined gauge tube should be connected to the inlet meter swivel by a flexible tube. The tap for this connection should be made in the standard size swivel at a point two swivel diameters from the inlet meter connection. The size of the tap should not be less than ⅛ in. and not over ¼ in. The tube for the connection should not be inserted beyond the inside wall of the swivel and all openings should be free from burrs.

The other end of the draft gauge should be connected in the same manner and location to the outlet swivel of the meter.

If it is not possible to locate these connections as outlined, be sure that all gauges in use have similar connections, at similar locations in respect to the meter connections. If the results are to be compared with other companies and other shops, adhere as closely as possible to the installation outlined, which is the location as set up by the AGA for determining the capacity of a meter. The gauge will be used, in most cases, at low flows which do not require these exacting specifications. Some companies check the differential of all meters at the capacity rate of flow as well as the check rate. If this is done the gauge connections should be made to AGA specifications.

The proper use of the differential gauge will improve the efficiency of any meter shop, reduce proving room time, and lengthen the accurate service period of meters, thereby accomplishing a substantial saving and improving the actual revenue of the utility. ■

The halogen lamp in gas distribution

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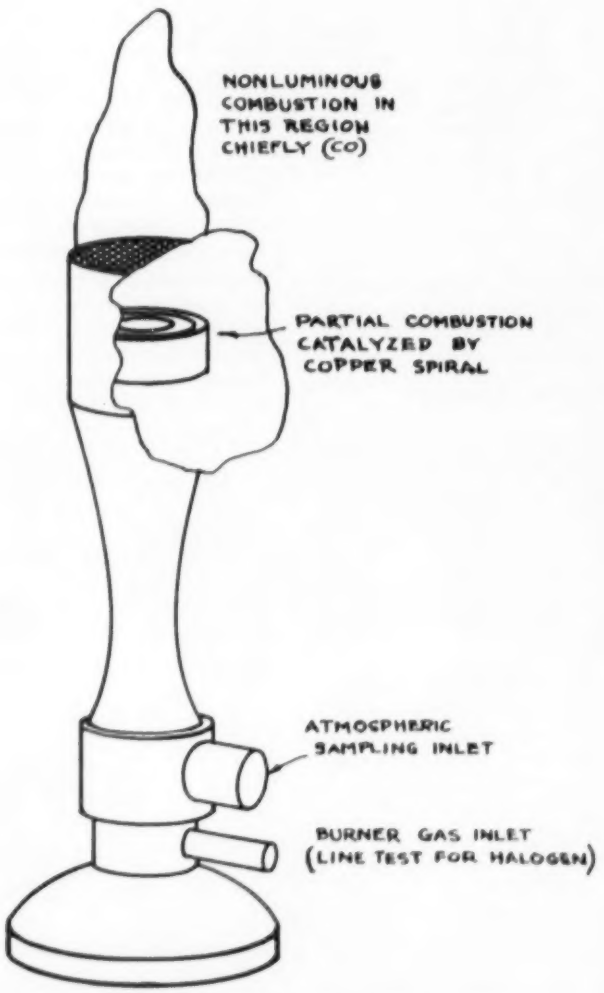
Vancouver, B. C.

SOME years ago we were interested in determining the velocity and pattern of flow in our distribution system. We were anxious to know how long it took the gas to get from a certain point in the trunk system to various points in the branch lines. We wanted this information partly to get an idea of the actual velocities in our systems so that we could compare them to the pipe loss formula, and also to see if all our lines were working, or whether some of them were obstructed and were being back-fed.

In this atomic age the first idea that crossed our minds was to introduce some radio-active gas into the main and trace it by the use of Geiger counters. We submitted this idea to the National Research Council and asked its advice.

The National Research Council was very enthusiastic about the idea. We were told that it was perfectly practical, but by the time the council had outlined the difficulties involved, the number of specially trained personnel that would have to be employed, and the number of Geiger counters that we would have to purchase, we abandoned the idea.

Then we got to wondering if there was some chemical that we could introduce into the gas that would not affect its use in any way, but could be traced by some simple device. Halo-


NONLUMINOUS COMBUSTION IN THIS REGION CHIEFLY (CO)
PARTIAL COMBUSTION CATALYZED BY COPPER SPIRAL
ATMOSPHERIC SAMPLING INLET
BURNER GAS INLET (LINE TEST FOR HALOGEN)

Cutaway drawing of the halogen sensitive gas burner.

The halogen lamp... It was made from an ordinary laboratory bunsen burner

gen and halogen lamps seemed the logical conclusion.

If you introduce halogen in the form of a gas into a flame that contains red hot copper, the halogen reacts with the copper and turns the flame a beautiful green that is very easily noticed. The halogen lamp is extremely sensitive, is very simple, and cheap. It has been used in the refrigeration industry for years for locating leaks in methyl-chloride and Freon systems, and is used in water works for tracing the chlorine in water.

Our laboratory set about to experiment with halogen lamps. A super-sensitive halogen lamp was devised that contributed greatly to the over-all success of our project.

The lamp is made from an ordinary laboratory bunsen burner. It has a coil of copper ribbon inserted in its throat. In use, it is first backfired into the air-mixer until the copper becomes red hot. The lamp is then blown out so that the gas passes up through the red hot copper, where it catalyzes on the surface of the copper, in much the same way that gas catalyzes on the surface of the platinum wire in explosimeters. The release of heat keeps the copper red hot.

Introduction of halogen

In use, the halogen can be introduced with the gas or it can be introduced with the primary air, but the most remarkable thing is the tiny quantity of halogen it takes to affect the flame. We have not done any quantitative tests, but it is safe to say that it would be in the magnitude of parts per million.

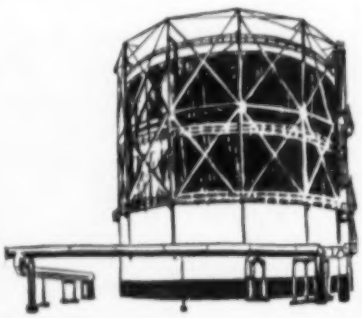
If a lamp is intended for use out-of-doors, it must be enclosed in a suitable chimney to keep the wind from disturbing the flame and eliminate the glare of the daylight. In sunlight, an aerated gas flame is almost invisible.

In preparing for our tests we decided to use Freon. We could have used carbon - tetrachloride, but we wanted something that would become a gas immediately upon hitting the gas stream, not a liquid that would evaporate slowly. Freon is non-toxic and in the quantities used, in no way affects the burning qualities of the gas. On the night of our test we set up observation stations in various parts of our distribution system and then introduced a slug of Freon into a 24-in. trunk line. We had previously synchronized watches and arranged for the slug to be released at exactly 5 o'clock. The slug of Freon was introduced from a cylinder through a ¼-in. tube and could not have amounted to more than 2 or 3 cu ft. This quantity proved more than ample. The moment the marked gas passed the test points the flames turned bright green.

We had suspected that people using copper kettles might experience a green discoloration in their gas flames, so we warned the trouble office to explain to anybody who inquired that if a peculiar color was noticed in the flame, it was caused by a trace gas that would soon disappear, and that it was harmless. We did not, however, receive a single call. This was probably due to the fact that the copper in the kettles was too cold to react with the halogen.

There is another use for the halogen lamp that is worth mentioning. The Philadelphia Gas Works backfills its gas mains as they are being installed and introduces some carbon-tetrachloride with the air when the main is pressurized for testing. It the test shows a leak, PGW rods down near the joints and aspirates samples through a halogen detector. The halogen detector in use is an electric device that is very sensitive. It is also quite expensive and cumbersome and requires 60-cycle ac to operate it, which means, of course, a portable ac generator.

We tried this method with success in Vancouver. Then the thought occurred that our halogen lamp might be just as sensitive. We tried it out and found that it was as sensitive, if not more sensitive than the electric halogen detector. It was also much more portable and had the added advantage of being much cheaper. It is now standard procedure with us if we have a leak in a pipeline to introduce Freon or carbon-tethachloride with the test air and then rod down by each weld, pull a sample of the atmosphere, and pass it through the air shutter of a halogen lamp. When used in this way the lamp is fueled from a small propane cylinder. We have used the halogen lamp for this purpose much more than the one for which it was originally designed.



Direction of flow

When tracing gas that is leaking from some buried main or service, it is helpful to be able to determine the direction of flow in the ground. A common method is to take samples from a number of openings and to work toward the strongest sample. The type of soil in the sampling hole has a lot to do with the amount of gas that issues from it, so that this method is very unreliable. We have discovered that if we drive a pipe in the ground and release a little Freon, it gets carried along by the transient gas. The direction of flow can easily be determined by which sampling holes show halogen in the gas.

We believe that our tests have shown that a suitable halogen gas, combined with the halogen lamp, can be used for tracing gas accurately, safely and economically. We have used it in the three methods mentioned, but, no doubt, there are other uses for it. For instance, in multiple regulator systems, by introducing a trace of halogen at each regulator and testing around the system, it could be determined just how far each regulator serves. The same would apply if there were several city gate stations supplying one system.

Perhaps, for testing gas furnaces for internal leaks, instead of using the smoke or sulfur candle test, we could introduce a little Freon or carbon-tetrachloride into the secondary air and test the registers with a halogen lamp.

Many ideas present themselves. We believe that the halogen lamp might very well become a valuable addition to the tools of our trade. ■

This article was adapted from a paper presented by J. Gemmell, mechanical superintendent, at the PCGA distribution conference technical section, Berkeley, Calif., April 10-11.

Draft control methods and equipment

By WALTER B. KIRK, Chief Research Engineer
and
E. H. PERRY JR., Research Engineer
AGA Laboratories Inc., Cleveland

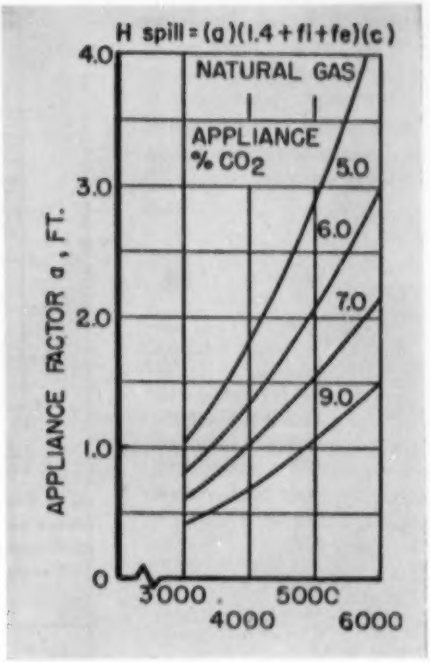


Fig. 1. Effect of appliance flue outlet heat loading and CO_2 concentration on appliance factor with a flue loss of 25%. Heat input based per square inc hof unobstructed appliance, flue outlet.

UNTIL such time as the gas industry and architects can agree that built-in piping for the mechanically powered venting of gas appliances is both desirable and feasible, vented gas appliances must be protected from the effects of atmospheric conditions inside and outside the home. The most effective device for affording this protection is the draft hood. Recommendations for their design were developed years ago by the American Gas Association Laboratories. When used on domestic equipment, draft hoods of this type still afford the best general protection known.

However, with the advent of streamlined appliances and lower ceilings, the original AGA draft hood designs began to look cumbersome. Many appliance designers have developed ingenious modifications of the basic draft hood designs for inclusion in the appliance jacket. This trend was particularly true in furnaces. The desire for such changes required much more basic information than had been developed in previous AGA research. By popular demand of the industry, Research Project DA-1-HA on Draft Control Methods and Equipment was created, and developed a draft hood design procedure. A formal report of this subject should become available this year.

As a result of our research, we learned that adequate protection would be provided against excessive updrafts if proper attention were given to spillage and downdraft characteristics. It is obvious that the draft hood location would be somewhere above the burner port level, and its relief opening should be at least 1 to 1½ flue pipe diameters away from any surface which might

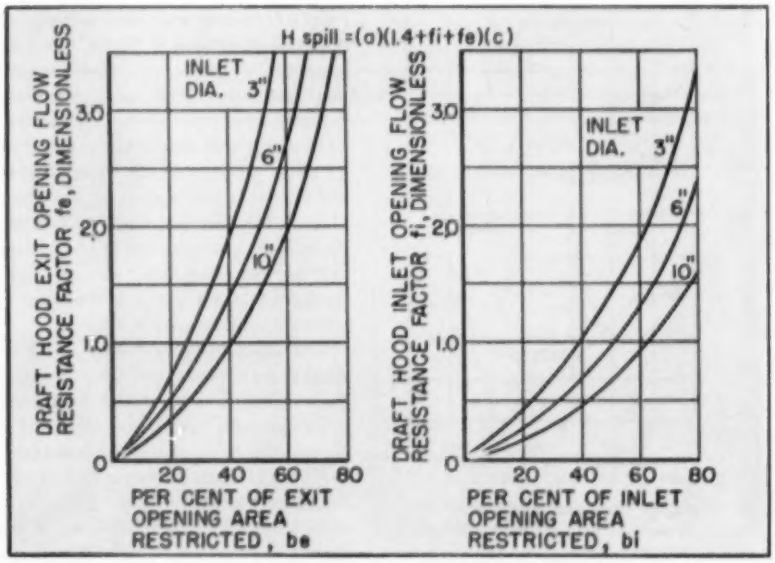


Fig. 2. Effect of draft hood inlet and exit restrictions upon resistance factors f_i and f_e.

obstruct complete venting through the relief opening. With these provisions, let's look at the two-step procedure of designing to prevent spillage and faulty downdraft operation. A horizontal to vertical hood is used in this example.

Spillage characteristics may be expressed by the equation:

$$H_s = a\,(1.4 + f_i + f_e)\,c$$

where: H_s = vertical stack height needed to prevent spillage, feet,

a = appliance factor representing appliance effect on spillage (rate, combustion, flame characteristics, internal friction, effective height), feet,

$(1.4 + f_i + f_e)$ = draft hood internal flow resistance plus inlet and exit friction factors, dimensionless, and

c = effect of entrained dilution air, dimensionless.

The appliance factor a is taken from curves plotted in *Fig. 1* for an assumed flue loss of 25%. The detailed procedure gives correction factors for other flue losses.

In the second term of the equation, we have the number 1.4, which represents the velocity head flow resistance of any type draft hood with no restrictions or baffles. The terms f_i and f_e refer to inlet and exist flow resistance. These may be due to actual restrictors in the planes of the inlet or exit openings—or they may be due to internal baffles whose effects are projected to these planes. These friction factors become important when designing for downdraft performance, although they are not needed for the initial calculations of the spillage procedure. They are arrived at by means of curves such as those illustrated in *Fig. 2*.

The effect of entrained dilution air on spillage, or term c, is determined by the ratio of the relief opening area to the inlet area of the draft hood, as shown in *Fig. 3*.

There are some helpful guides for selecting the relief opening area to inlet opening area ratio. For horizontal to vertical hoods:

1. The relief opening area should be at least 1½ times the exit opening area. In the case of a "built-in" horizontal to vertical draft hood, the relief opening area is the minimum cross-sectional area through the scoop.

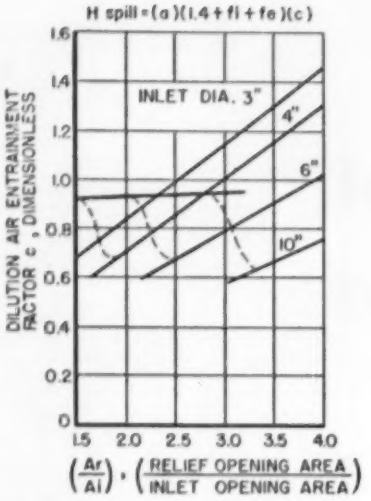


Fig. 3. Chart shows how effect of entrained dilution air (c) is determined by ratio of the relief opening area to the inlet area of the draft hood.

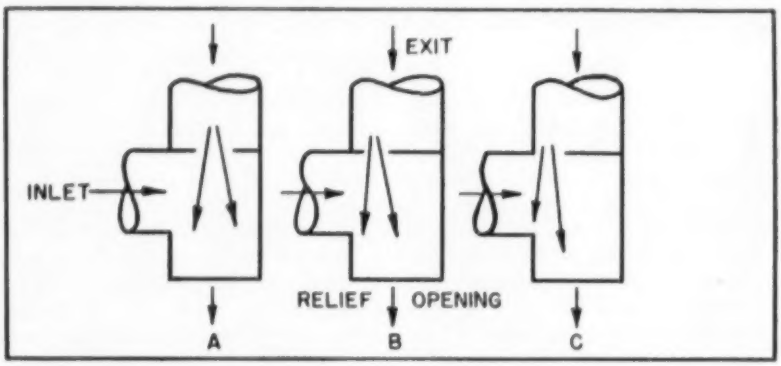
2. The relief opening should be located between 1- and 2-in. below the plane or lower edge of the draft hood inlet opening. Except for critical performance, an increase in the skirt length will have no marked effect upon spillage performance. However, increasing the skirt length beyond a few inches unnecessarily increases the flow resistance through the relief opening with an accompanying detrimental effect upon downdraft performance.

3. The major portion of the relief opening area should be located such that it is within the boundary described by a radius of one exit pipe diameter from the axis of the exit opening.

4. The plane of the relief opening should be located at least one exit diameter above a horizontal obstructing surface.

Using these guides, and finding c from the graph, completes the spillage equation for a first approximation. The downdraft characteristics must then be considered as the second step.

Three general types of downdraft



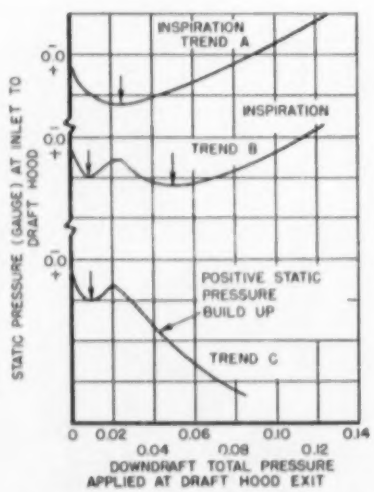


Fig. 4 and 4a. Three general effects of total downdraft pressure on draft hood inlet static pressure. Orifice analogies for the trends in the chart are shown below.

performance are possible for draft hoods, as illustrated in *Fig. 4*. Since the per cent CO_2 of the appliance flue gases increases as the draft hood inlet static pressure becomes more positive, the CO_2 trends will be the same as the inlet static pressure trends. These trends were based upon a starting condition of zero inlet static pressure when the downdraft total pressure applied to the exit of the draft hood was zero, and the buoyancy force was in the form of velocity pressure only.

The relationships between orifice locations and trends in *Fig. 4* simplify the conditions to be used subsequently in determining draft hood factors. The orifice effects, or any other internal baffle effect, must be transposed or projected into terms of restrictions, hypothetically located in the planes of the draft hood inlet and exit. Even an appliance flue collar may contain a restric-

tor whose effect at the plane of the draft hood inlet must be projected. Despite the necessity for placing all such effects in terms of draft hood inlet and exit restrictions, however, these terms then always result in one of the three trends sketched in *Fig. 4*.

Fig. 5 indicates the type of trend that may be expected with a horizontal to vertical draft hood.

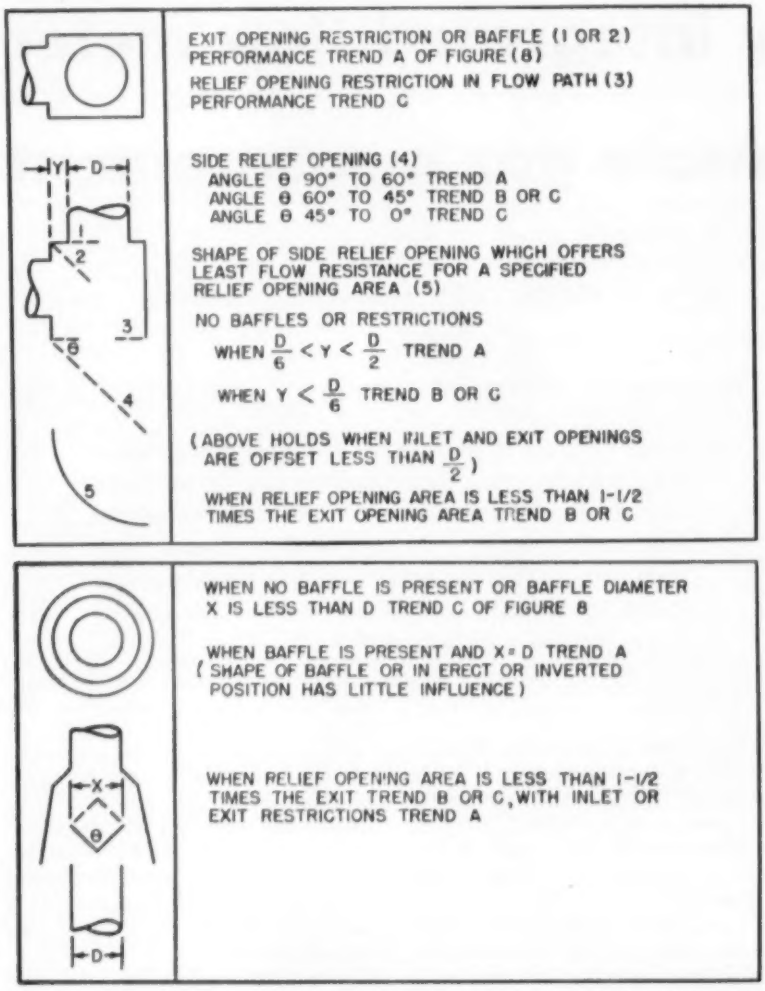

EXIT OPENING RESTRICTION OR BAFFLE (1 OR 2)
PERFORMANCE TREND A OF FIGURE (8)
RELIEF OPENING RESTRICTION IN FLOW PATH (3)
PERFORMANCE TREND C
SIDE RELIEF OPENING (4)
ANGLE θ 90° TO 60° TREND A
ANGLE θ 60° TO 45° TREND B OR C
ANGLE θ 45° TO 0° TREND C
SHAPE OF SIDE RELIEF OPENING WHICH OFFERS LEAST FLOW RESISTANCE FOR A SPECIFIED RELIEF OPENING AREA (5)
NO BAFFLES OR RESTRICTIONS
WHEN D/6 < Y < D/2 TREND A
WHEN Y < D/6 TREND B OR C
(ABOVE HOLDS WHEN INLET AND EXIT OPENINGS ARE OFFSET LESS THAN D/2)
WHEN RELIEF OPENING AREA IS LESS THAN 1-1/2 TIMES THE EXIT OPENING AREA TREND B OR C
WHEN NO BAFFLE IS PRESENT OR BAFFLE DIAMETER X IS LESS THAN D TREND C OF FIGURE 8
WHEN BAFFLE IS PRESENT AND X = D TREND A
(SHAPE OF BAFFLE OR IN ERECT OR INVERTED POSITION HAS LITTLE INFLUENCE)
WHEN RELIEF OPENING AREA IS LESS THAN 1-1/2 TIMES THE EXIT TREND B OR C, WITH INLET OR EXIT RESTRICTIONS TREND A

Fig. 5 and 5a. Top chart shows probable downdraft performance trends for horizontal to vertical draft hoods. Bottom chart shows probable downdraft performance trends for concentric vertical draft hoods. Trends A, B and C refer to Fig. 4.

The relationship between the downdraft total pressure and draft hood inlet static pressure shown in *Fig. 4* is governed by draft hood factors tied to these two variables, the heat input rate of the appliance, and the ratio of relief opening area to inlet opening area. These relationships are graphically shown in *Fig. 6*.

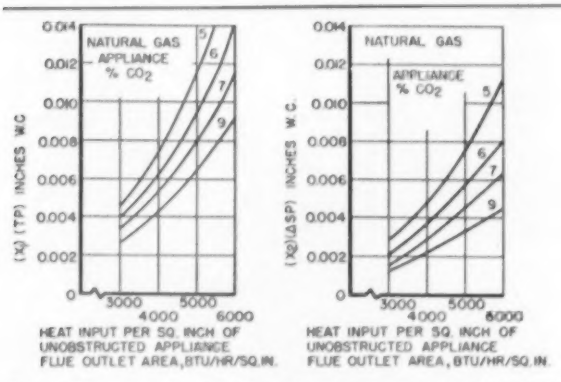
Note that the area ratio has been established in the spillage calculations, and that this ratio determines the draft hood factors in the lower curves. These values and input rate loading of the appliance flue outlet determine the necessary pressures in the upper curves.

To obtain the magnitude of the static pressure imposed upon the appliance, the positive static pressure increase due to the draft hood with no stack must be added to the above change in static pressure (assuming a zero gauge static pressure without a draft hood). A reasonable value would be 0.005-in. water column. This added value represents the maximum positive static pressure that would be imposed upon the appliance if its downdraft trend were of type A. For trends B and C, the draft hood factors are independent of relief opening area and are:

$$X_1 = 2.23\ (1 - b_s)$$
$$X_2 = 1.23$$

If the above described calculations result in a maximum positive static pressure at the draft hood inlet less than the critical value for which the appliance will function properly without a draft hood, our work is done. However, if this first approximation exceeds the critical value, the procedure must be re-worked with modifications to the draft hood. ■

This article is adapted from a talk presented at the AGA research and utilization conference held in Cleveland, April 3-4.


NATURAL GAS
APPLIANCE % CO2
(XQ) (TP) INCHES W.C.
(XQ)(ΔSP) INCHES W.C.
HEAT INPUT PER SQ. INCH OF UNOBSTRUCTED APPLIANCE FLUE OUTLET AREA, BTU/HR/SQ.IN.

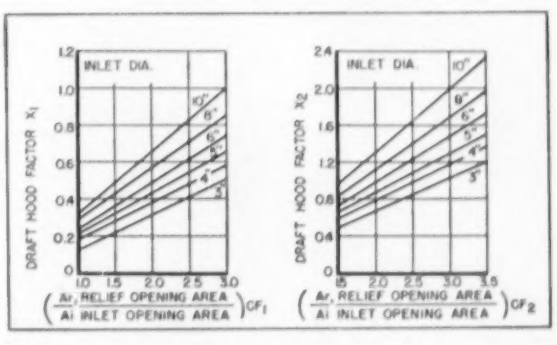

INLET DIA.
DRAFT HOOD FACTOR X1
DRAFT HOOD FACTOR X2
(Ar, RELIEF OPENING AREA / Ai INLET OPENING AREA) CF1
(Ar, RELIEF OPENING AREA / Ai INLET OPENING AREA) CF2

Fig. 6. Charts at left show effect of appliance upon the draft hood downdraft performance. Effect of draft hood relief opening area, baffles and restrictions upon the factors X_1 and X_2 are shown in charts at right.

Continuously integrated flow meter provides accurate gas measurement

By R. Y. POGONTCHEFF • Shell Oil Co., Midland, Texas

Tests conducted recently by a major gas producer have indicated that more accurate gas measurement was obtained by use of a continuously integrating flow meter than by conventional methods. These tests showed that by increasing the chart rotational speed, the possibility of human error in the conventional method was decreased.

METERING applications in the measurement of gas flow in the production of the oil and gas industry range from the most favorable to the most difficult. Where flow is more or less constant the problem presents little or no difficulty in obtaining acceptably accurate and consistently reliable measurements. In a great many instances this condition does not exist and the flow rate may vary from a moderate, slow-speed fluctuation to a violent oscillation. As the frequency and magnitude of these flow rate changes increase, the problem of metering becomes increasingly difficult and expedience has often dictated acceptance of somewhat less accurate results.

In gas measurement with conventional orifice meters, the actual method of assimilating the signal output from the orifice plate and the application of this to calculations of total flow have undergone considerable investigation by instrument manufacturers and have resulted in the development of major advances. One of the developments is the presence on the market of several types of continuously integrating flow meters with automatic pressure compensation.

Conventional gas-flow measurement methods have consisted of recording on charts static pressure and differential pressure across an orifice plate. This chart is then manually integrated to obtain an average value of the square root of the two recorded values for subsequent calculations. This method, although laborious, is accurate when flows are more or less constant, but has severe limitations where flows constantly fluctuate.

The electronic flow meter with con-

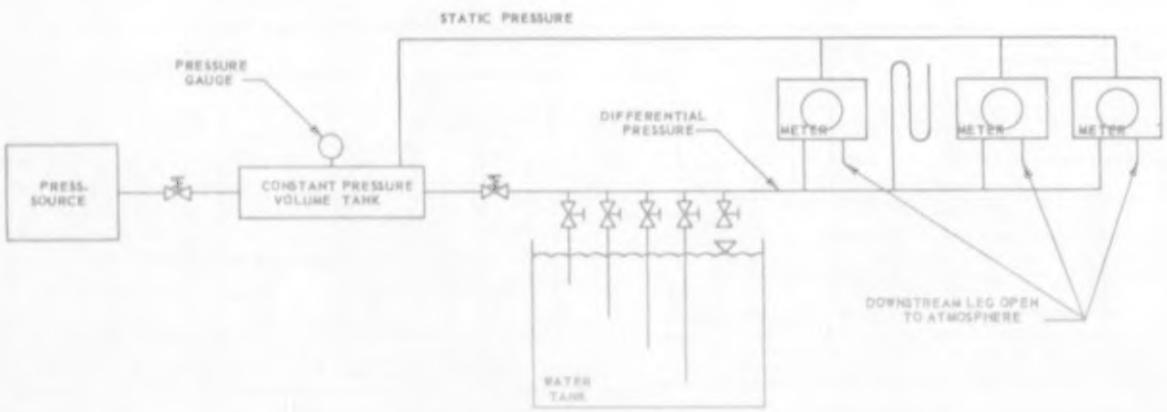


Fig. 1. Schematic diagram of test apparatus.

TABLE 1. Pattern of Test Differentials

	Total test time Min.	Static pressure Psig	Chart Test Pattern Duration of % Full Scale 25% Sec.	50% Sec.	75% Sec.
Test I	55	25	30	—	30
Test II	52	25	50	—	10
Test III	58	25	10	—	50
Test IV	54	25	20	20	20
Test V	55	25	300	300	300

tinuous integration and automatic pressure compensation is so constructed that the instantaneous differential and static pressures are continuously combined and fed to an integrator as rates of flow of standard cubic feet of gas. The integrator introduces the time element and the summation of the product of time and flow rate results in the desired end result which is total volume of gas reduced to standard conditions.

It can be seen that the major change is not in the basic method of indirectly measuring flow by differential across an orifice plate, but is in the treatment of the signal obtained from the orifice plate for the eventual conversion to volume of fluid.

The following investigation was carried out to obtain operational data on a continuously integrating flow meter and to compare the following two methods of measuring gas that is produced in the normal production of oil wells.

1. The conventional method which represents present day practice.

2. The continuously integrating method with automatic pressure compensation.

A schematic diagram of the apparatus used for the first series of tests is shown in *Fig. 1*. The apparatus was connected to the residue gas line supplying the lease, which served as a source of approximately constant gas pressure. This pressure was then reduced by means of a pressure regulator to a constant pressure in a small-volume tank which served two purposes. The static pressure elements of all the meters were tied directly into this tank; and by adjusting the pressure regulator on the line into the tank, any static pressure desired could be obtained. A second outlet from the volume tank supplied gas to the section controlling the differential pressure acting on the meters. The quantity of gas being bled off from the volume tank was only that which escaped from the bubble tubes, and the small variations in this were not of sufficiently large magnitude to cause any discernible pressure variations in the volume tank.

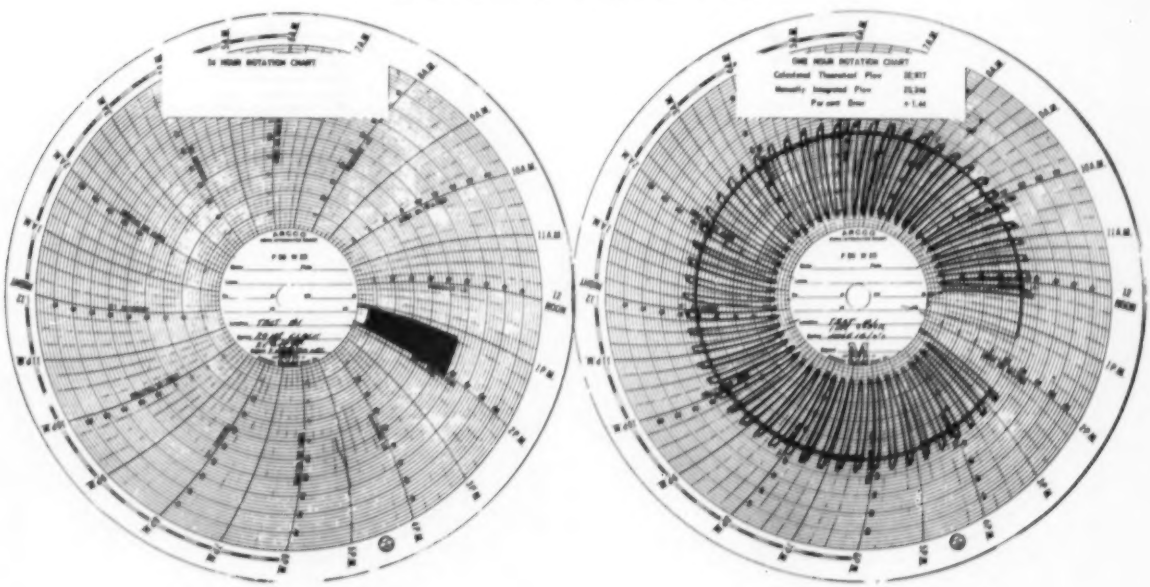
The downstream pressure connections of the orifice meters were left open to the atmosphere and the upstream pressure connections were tied into a back-pressure system consisting of tubes immersed to various depths in a tank of water. The desired differential or back pressure could then be obtained by letting the gas bubble through the appropriate tube. The lengths of these tubes had been so chosen that differentials corresponding to flows of 0, 12.5, 25, and 50 Mcf/hr (0, 25, 50 and 100% full-scale flow, respectively) were available. Small pet cocks were installed in each tube so that very rapid changes from one differential to another could be obtained by merely directing the flow from one tube to another.

A water manometer was connected into the back-pressure system at the same point as the connections for the meters. This manometer was the primary measuring device, and calibration of the bubble tubes and differential pens of the meters was done according to readings obtained on it. A continuous check on pressures throughout the tests was also possible by merely glancing at the manometer which was located beside the water tank.

A stop watch was used for all time measurements, and accuracies of one second were easily maintained throughout the tests.

Three meters were used for this investigation, two conventional and one electronic. The two conventional meters were standard Barton recording

Fig. 2. Test I (75% - 30 sec., 25% - 30 sec.).



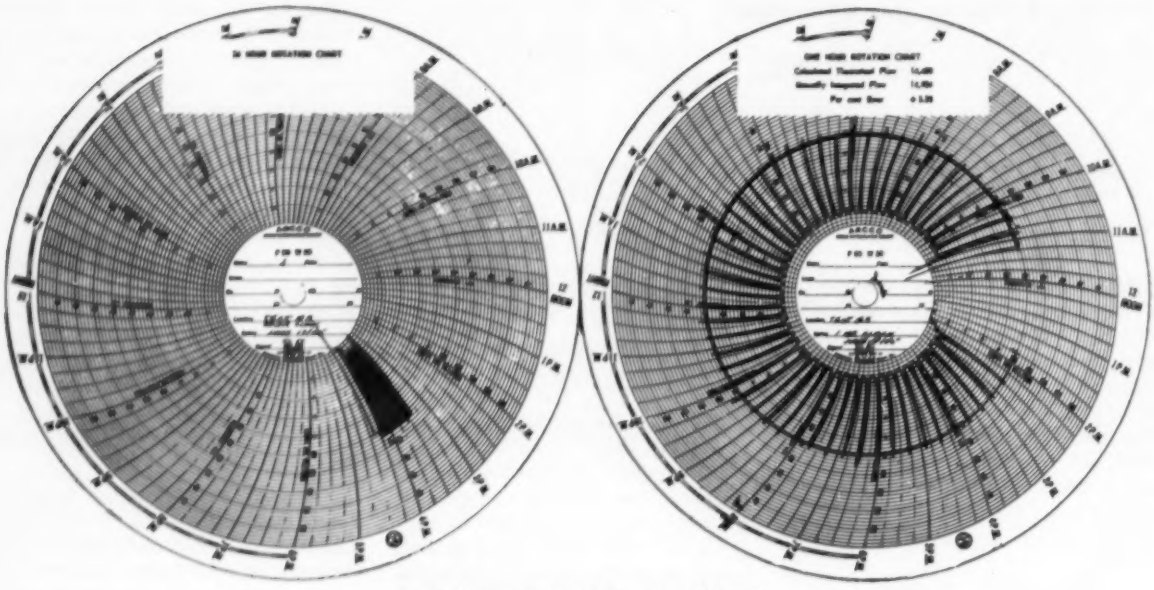


Fig. 3. Test II (75% - 10 sec., 25% - 50 sec.).

flow meters, of which one was equipped with a 24-hr clock and the other a 1-hr clock. The electronic instrument was a Penn flow meter, Style X912E Sp., which also utilized a Barton bellows. The Barton flow meters were 20 in. of water differential for full-scale deflection, and the Penn meter was 20 in. of water differential for full-scale deflection at 25 psi, with pressure compensation from 23 to 27 psig.

Basic data used in the sizing of the orifice plate so that 20 in. of water differential would be the equivalent of a flow rate of 50 Mcf/hr were:

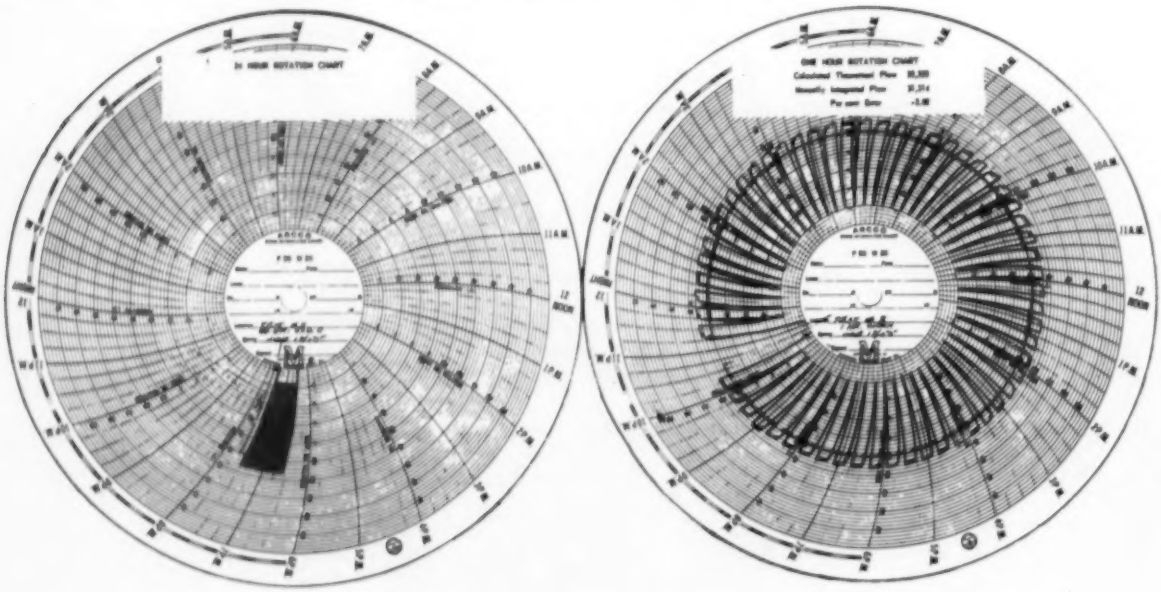
Railroad commission regulations

Pressure base = 14.65 psia
Temperature base = 60° F
Specific gravity = 0.85 (average)
Atmospheric pressure = 13.2 psia
Flowing temperature = 63° F (average)

Using the foregoing data with a meter run line size of 4.026 in. and flange taps, resulted in an orifice plate size of 2.6764 in. With similar calculations the water differential required for 25, 50, and 75% of rated flow were calculated and resulted in 1.250, 5.000, and 11.250 in. of water. These were the actual differentials used during the Series I tests and, it should be noted, are 25, 50, and 75% of rated flow and not of full-scale water differential.

Gas volume readings on the Penn meter were indicated on a counter at-

Fig. 4. Test III (75% - 50 sec., 25% - 10 sec.).



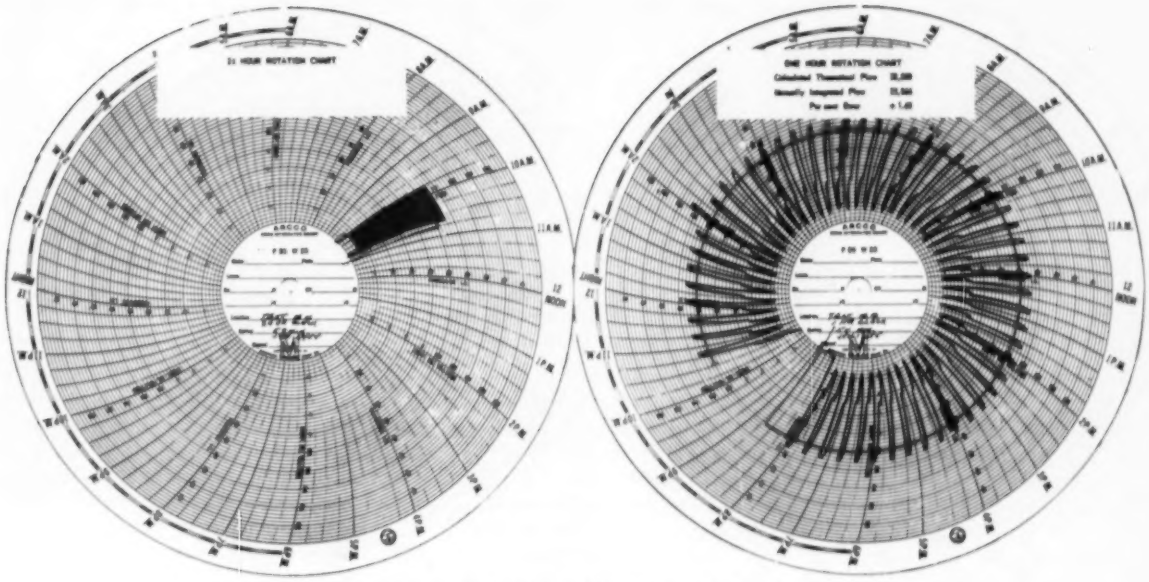


Fig. 5. Test IV (75% - 20 sec., 50% - 20 sec., 25% - 20 sec.).

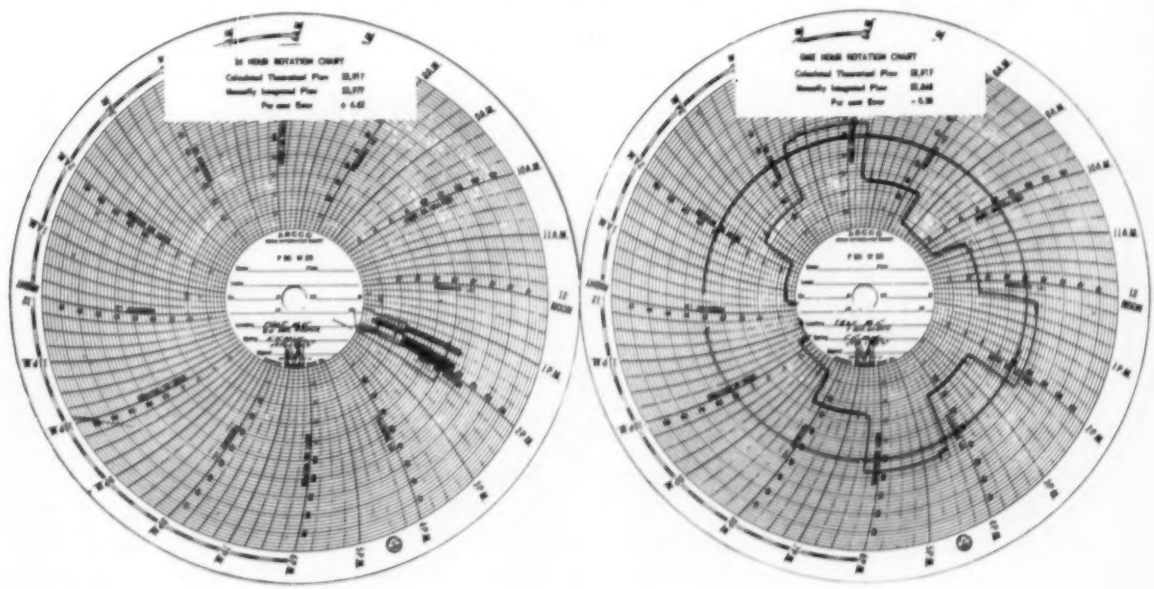
tached to the output shaft of the Librascope integrator. Charts obtained from the Barton meters were integrated manually on an Emco-McGaughy integrator according to normal procedures. As an added precaution all charts of 1-hr rotation were also integrated, using a Foxboro square root single-point planimeter. In this latter integration particular emphasis was placed on accuracy, and all charts were integrated several times to minimize human errors.

Procedure

The tests were divided into two types or series. The first series, i.e., Tests I to V inclusive, were controlled tests in which the differential and static pressures were applied manually and controlled both in magnitude and duration to conform to predetermined patterns (see *Fig. 2 to 6,* inclusive). In this manner, the characteristics and limitations of the instruments could then be accurately established and the information thus obtained applied to subsequent use of these methods of measuring gas flow under normal well-flowing conditions. This was done in the second series of tests (Tests VI to XI, inclusive).

The three meters (series I) were connected to the test apparatus as shown in *Fig. 1.* Each test was run for a predetermined period of time and the pattern of differential repeated continuously for the duration of each test (see *Table 1*). These tests were limited to

Fig. 6. Test V (75% - 5 min., 50% - 5 min., 25% - 5 min.).



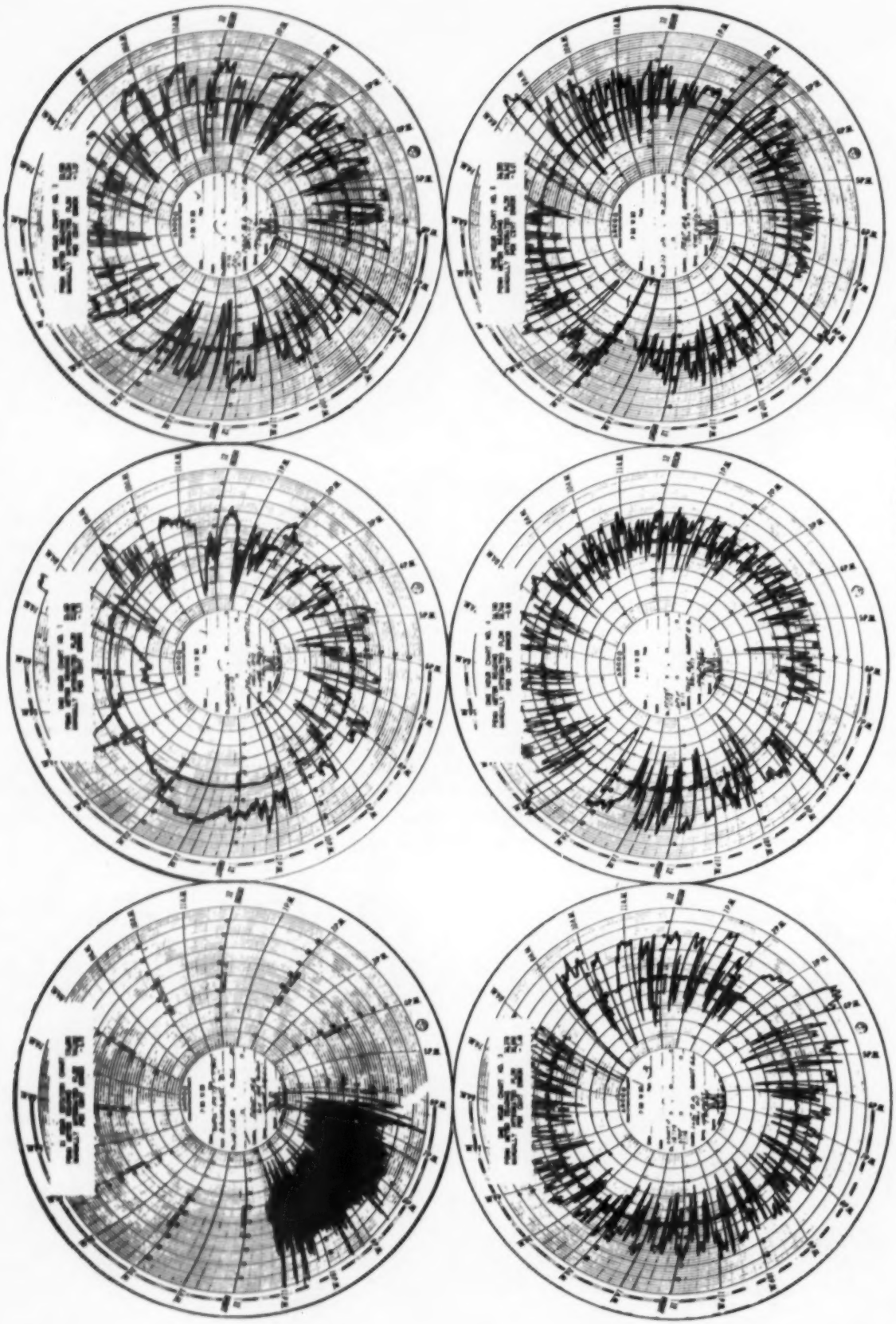


Fig. 7. Test VI, well flowing test. Penn meter total flow 176,090, 1-hr charts total flow 175,510. Error, 0.33%.

TABLE 2. Series I Summary of Test Results, Controlled Differential and Static Pressures

	—Test I—		—Test II—		—Test III—		—Test V—		—Test V—	
	Volume, cu ft	Error, %	Volume, cu ft	Error, %	Volume, cu ft	Error, %	Volume, cu ft	Error, %	Volume, cu ft	Error, %
Theoretical calculated flow	22,917	—	14,450	—	32,222	—	22,500	—	22,917	—
Controlled integrating meter reading	22,780	—0.60	14,360	—0.62	31,705	—1.60	22,570	+0.31	22,665	—1.10
1-hr rotation chart—Hobbs	23,246	+1.44	14,924	+3.28	31,314	—2.82	22,866	+1.63	22,848	—0.30
1-hr rotation chart—Midland	23,258	+1.49	14,882	+2.99	30,168	—6.37	22,376	—0.55	22,536	—1.66
24-hr rotation chart—Midland	—	—	—	—	—	—	—	—	23,977	+4.62

CHART TEST PATTERN

Percent of Rated Flow	Time Duration of Percent Rated Flow—Seconds				
	Test I	Test II	Test III	Test IV	Test V
25	30	50	10	20	300
50	—	—	—	20	300
75	30	10	50	20	300

a time less than 60 minutes so that a complete test was contained on a chart obtained from the meter having a 1-hr clock.

All of these tests were run using the center half of the flow range since this is considered the optimum range of operation for the meters. Applied differentials were continuously checked by means of the water manometer. All time measurements were made by a stop watch and accuracies of one second maintained.

The series was so devised that although the patterns of differentials were varied from one extreme to the other, the records as produced on a chart obtained from a 24-hr clock were identical for Tests I to IV (see *Fig. 2 to 5*, inclusive). The charts from the 1-hr rotation conventional meter were then integrated, and the total flow obtained from the counter on the continuous integrating meter. Theoretical flows corresponding to the applied differentials were calculated and the value thus obtained judged to be correct. Values obtained by the two methods of measuring gas flow were then compared to the theoretical, and percentage error based on theoretical flow was computed.

The second series of tests was run on actual wells flowing through the meter run of the tank battery. For Tests 6 and 7 the three meters were tied in across the same orifice plate so that all three records were obtained simultaneously with the same differential and static pressures acting on each (see *Fig. 7 and 8*). The results obtained from the three methods of measuring were then compared and the error computed based on the assumption that the continuously integrating meter supplied the most correct value. Because it was necessary to change charts on the meter containing the 1-hr clock, the well was shut in periodically, but this was kept to a minimum in that the shut-in period was of only 2-minute duration in each hour, resulting for all practical purposes in continuous flow.

Tests VIII, IX, X and XI were similar to VI and VII with the following exceptions. The 1-hr charts were omitted and the tests were run continuously from start to finish. In addition, these tests were run by the switcher of the lease and consequently represent results as normally obtained by field operations, personnel, and methods (see *Fig. 9*).

Prior to beginning any tests the three meters were calibrated using the backpressure apparatus assembled for this investigation. Calibration of the conventional meters was comparatively straightforward and consumed relatively little time, of the order of three quarters of an hour for each meter. The continuously integrating meter, however, because of the additional functions performed, took considerably longer, and it is estimated would require of the order of three to six hours once familiarity is acquired.

The normal test chart obtained in the Wasson Field has a wide, ragged band of ink for the differential pressure record resulting from the continuous oscillation of the differential pen. Several patterns were run to determine the frequency of pen oscillation necessary to produce this overlapping of the pen markings, and it was determined that at approximately mid-scale the period of oscillation must be kept to approximately 60 seconds or less. Based on this fact, the patterns devised for Series I tests were limited to periods of oscillation not greater than 60 seconds.

During the establishment of the foregoing data, considerable variation in the rate of response for each meter was observed. All meters were equipped with Barton bellows and had the pulsation dampening screws backed off completely. Subsequently, it was found that the conventional meters were sensitive to the friction created by the pressure of the pen against the chart. When this friction is excessively high, as can result when the pen arm is bent, response is very slow and erratic and results in the pen moving in intermittent steps toward the equilibrium point.

TABLE 3. Series II Summary of Test Results, Well Flowing Tests

	—Test VI—		—Test VII—		—Test VIII—		—Test IX—		—Test X—		—Test XI—	
	Volume, cu ft	Error, %	Volume, cu ft	Error, %	Volume, cu ft	Error, %	Volume, cu ft	Error, %	Volume, cu ft	Error, %	Volume, cu ft	Error, %
Continuous integrating meter reading	176,090	—	113,670	—	140,900	—	172,230	—	88,200	—	155,650	—
24-hr rotation chart—Midland	164,265	—6.72	107,640	—5.30	137,228	—2.61	176,253	+2.34	82,898	—6.01	147,430	—5.28
1-Hr Rotation Charts—Hobbs							**1-Hour Rotation Charts—Midland**					
Chart No. 1	32,888	—1.71	*20,623	—			Chart No. 1	33,495	+1.00	20,633	—	
Chart No. 2	34,534	+1.87	*22,377	*—0.19			Chart No. 2	35,090	+3.51	22,387	—0.14	
Chart No. 3	35,800	—1.40	22,414	+0.64			Chart No. 3	36,280	—0.08	22,695	+1.91	
Chart No. 4	35,746	—0.98	23,806	—0.85			Chart No. 4	36,206	+0.29	24,162	+0.63	
Chart No. 5	36,542	—0.61	24,458	+0.61			Chart No. 5	36,535	+0.59	24,651	+1.40	
Total 1-hr charts—Hobbs	175,510	—0.33	113,678	+0.01			Total 1-hr charts—Midland	177,596	+0.86	114,528	+0.75	

*Continuously integrating meter reading not taken at end of first hour. Error based on two hours flow.

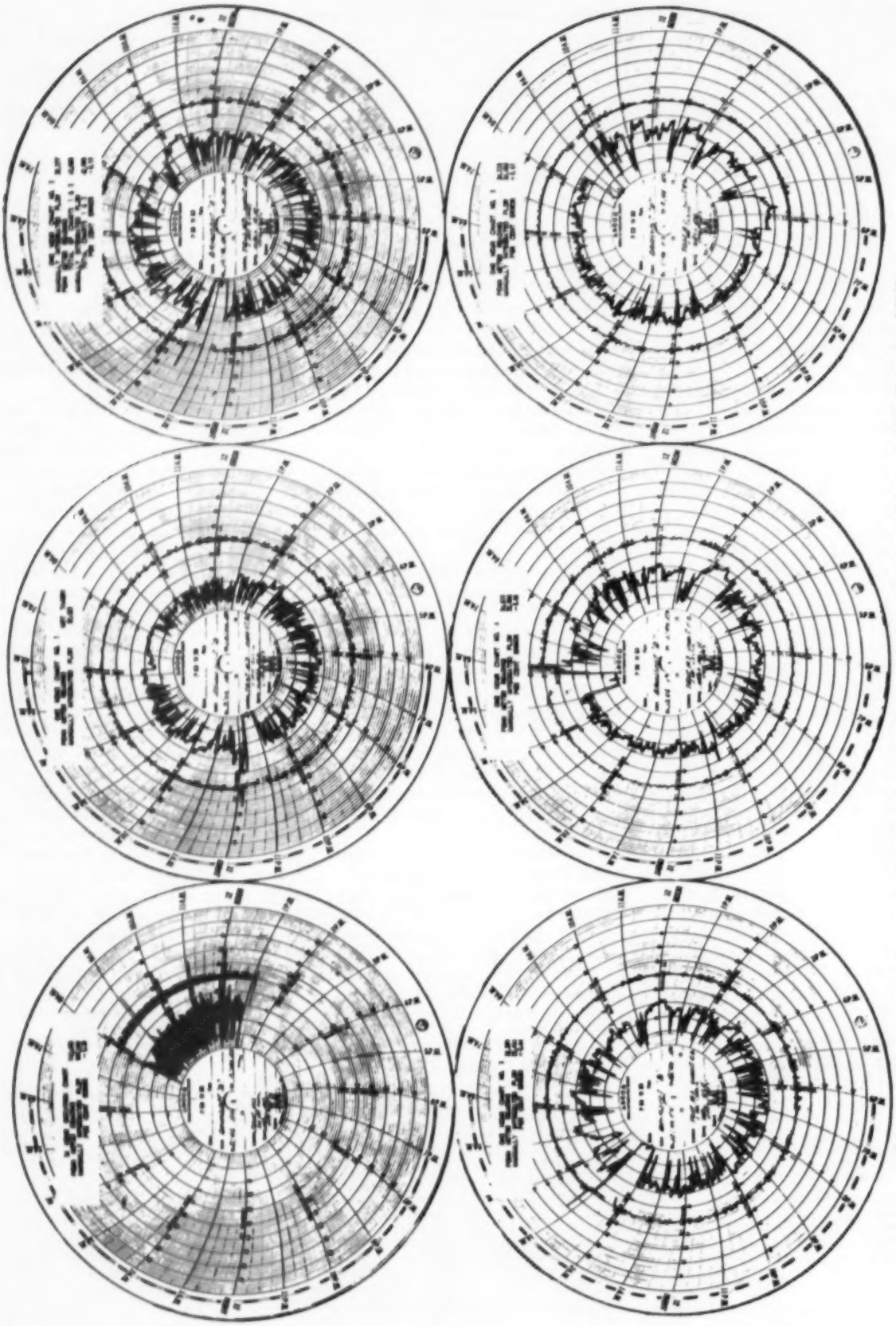


Fig. 8. Test VII, well flowing test. Penn meter total flow 113,670, 1-hr charts total flow 113,678. Error, plus 0.01%.

TABLE 4. Computation Data, Conventional Meter, Midland Integration Data

	24-Hour Clock				1-Hour Clock					Error		
	Integ. Constant	Orifice Constant	Integ. Reading	Meas. Flow Std., cu ft	Integ. Constant	Orifice Constant	Integ. Reading	Meas. Flow Std., cu ft	Calc. Theo. Flow Std., cu ft	24-Hr Clock, %	1-Hr Clock, %	Continuously Integrating Meter Std., cu ft
Test #I	.141	1809			.00578	1809	2188	23,258	22,917		+1.49	
II							1400	14,882	14,450		+2.99	
III							2838	30,168	32,222		—6.37	
IV							2105	22,376	22,500		—0.55	
V							2120	22,536	22,917		—1.66	
VI			644	164,265						—6.72		176,090
Chart #1							3151	33,495			—1.00	33,460
2							3301	35,090			+3.51	33,900
3							3413	36,280			—0.08	36,310
4							3406	36,206			+0.29	36,100
5							3437	36,535			+0.59	36,320
Test #VII			422	107,640						—5.30		113,670
Chart #1							1941	20,633*				
2							2106	22,387*			—0.14*	43,080*
3							2135	22,695			+1.91	22,270
4							2273	24,162			+0.63	24,010
5							2319	24,651			+1.40	24,310
Test #VIII			538	137,228						—2.61		140,900
IX			691	176,253						+2.34		172,230
X			325	82,898						—6.01		88,200
XI			578	147,430						—5.28		155,650

*Continuously integrating meter reading not taken at end of first hour. Error based on two hours flow.

The final point of rest is not necessarily the true differential since the friction and moving force may just be equal at some intermediate point. This condition was actually present in one of the meters and was corrected in both conventional meters by adjusting the pen until only sufficient pressure to obtain marking was present.

Of considerable interest was the fact that even after adjustment of the conventional meters, it was found that the continuously integrating meter had a faster rate of response and thus reached its equilibrium point in less time than either of the other two conventional meters. This feature is of prime importance when metering rapidly varying flows. Evidence of this may be seen in *Fig. 10*, which shows charts obtained simultaneously from the continuously integrating meter and the conventional meter containing the 1-hr clock. The applied differential correspond to 1.250 and 11.250 in. of water on the conventional meter chart, and 12.5 and 37.5 Mcf of gas, respectively, on the continuously integrating meter chart. It is apparent that the faster rate of response of the continuously integrating flow meter enabled it to follow more accurately the rapidly changing differentials.

From inspection of the conventional meter 1-hr charts of the Series I tests (see *Fig. 2 to 6*, inclusive), it is evident that the differential pen approaches a given differential in a manner, varying with the magnitude of this differential pressure. The initial speed of approach is very rapid and apparently is maintained to within one chart division of the final equilibrium value. The time required to travel this last chart division varied from approximately 55 seconds at quarter scale to 35 seconds at three-quarter scale. This characteristic is most readily seen on the hour chart on *Fig. 6*.

A summary of the results obtained from the entire series of tests is presented in *Tables 2 and 3* for convenience in comparison with individual calculations presented in *Tables 4 to 7*, inclusive.

Tests I to IV (series I) had been designed to produce identical types of records on 24-hr rotation charts, as may been seen in *Fig. 2 through 5*. It is evident that had this type of recording been used in attempting to measure the simulated flow, the volumes obtained would have been unreliable, because all charts are identical in appearance, yet the simulated flow varied in total volume from 14,450 to 32,222

TABLE 5. Computation Data—Hobbs Integration, Conventional Meter—1-Hour Clock, Controlled Differential and Static Pressures

	Total Time of Test Min.	Static Press. Psic	Differential Pressure			Combined Flow Factor	Meter Constant	Meas. Total Flow Std., cu ft	Calc. Theor. Flow Std., cu ft	Percent Error	Chart Test Pattern		
			Planimeter Rdg.	Average	20-in. Extension						Duration of % Full Scale-Sec. 25%	50%	75%
Test # I	55	25	4.616										
			4.685	4.651	4.32	12.85	1809	23,246	22,917	+1.44	30	—	30
II	52	25	2.996										
			2.977										
			2.984	2.986	1.78	8.25	1809	14,924	14,450	+3.28	50	—	10
III	58	25	6.274										
			6.232	6.253	7.82	17.31	1809	31,314	32,222	—2.82	10	—	50
IV	54	25	4.589										
			4.565	4.577	4.19	12.64	1809	22,866	22,500	+1.63	20	20	20
V	55	25	4.600										
			4.547	4.574	4.18	12.63	1809	22,848	22,917	—0.30	300	300	300
						Total Test Results		115,198	115,006	+0.17			

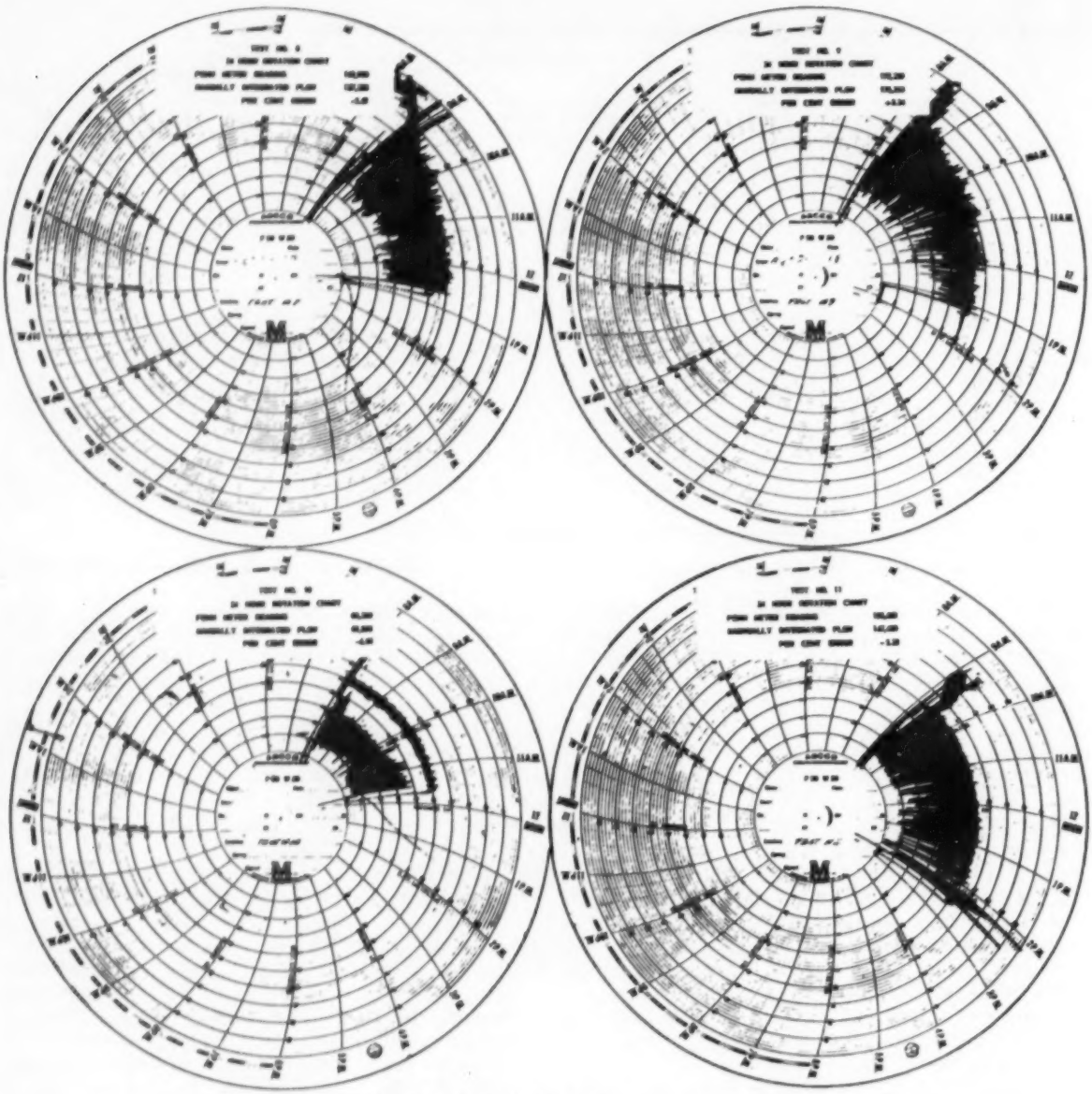


Fig. 9. Charts showing effect of variation in rate of response. Applied differential pressures were 1.25 and 11.25 in H_2O corresponding to 12,500 and 37,500 cu ft per hr.

cu ft. The variations in flow used during this series of tests are extremes which probably would not be encountered in actual practice, but they are illustrative of what can result from improper application of techniques, which are acceptably accurate under relatively constant flow conditions.

The charts obtained by the use of 1-hr rotation clocks illustrate how this common and simple expedient can be used to increase greatly the reliability of what is essentially the conventional method of measuring gas flow. Although the pen movement on both meters was for all practical purposes the same, the higher rotational speed of the chart on the 1-hr clock produced a much more intelligible record, with attendant increase in the reliability of calculated volumes.

An inspection of the values obtained by the fast clock method and routine integration shows errors varying from —6.37 to +2.99%. However, when these same charts were integrated and special care taken to minimize manual errors, the range of errors was from —2.82 to +3.28%. Thus, the error introduced by the human element is readily apparent.

The results obtained from the continuously integrating meter for these same tests have a much greater consistency and much smaller range of errors. The range of errors obtained, —1.60 to +0.31%, is considered to be within acceptable limits and is believed to be of the same order of accuracy as the test methods.

Test V was designed to produce legible records on all three charts and was believed representative of the results that would be obtained when the flow is varying but the frequency of variation sufficiently low that legible records would be produced on both the 24-hr and 1-hr rotation charts. This resulted

TABLE 6. Computation Data—Hobbs Integration, Conventional Meter—1-Hour Clock, Test VI—Well Flowing Test

Test VI	Differential Pressure: Planimeter Rdg.	Differential Pressure: Average	Differential Pressure: 20-in. Extension	Static Pressure: Planimeter Rdg.	Static Pressure: Average	Static Pr. Extension	Combined Extension Factor	Meter Constant	Meas. Flow Conv. Meter	Meas. Flow Cont. Integ.	Conv. Meter Percent Error
Chart #1	6.804			6.758							
	6.751	6.778	9.19	6.746	6.752	22.8	18.18	1809	32,888	33,460	—1.71
2	6.992			6.874							
	7.050	7.021	9.86	6.889	6.881	23.7	19.09	1809	34,534	33,900	+1.87
3	7.260			6.868							
	7.321	7.291	10.63	6.858	6.863	23.6	19.79	1809	35,800	36,310	—1.40
4	7.271			6.886							
	7.268	7.270	10.57	6.871	6.879	23.7	19.76	1809	35,746	36,100	—0.98
5	7.380			7.025							
	7.309	7.345	10.79	7.018	7.022	24.7	20.20	1809	36,542	36,320	—0.61
						Total Flow Test Results			175,510	176,090	—0.33

in the 24-hr rotation chart producing the greatest error, +4.62%, followed by the routine integration of the 1-hr rotation chart with —1.66%, the continuously integrating meter with —1.10%, and the non-routine integration of —0.30%. In this instance, the more careful integration of the 1-hr rotation chart proved the most accurate.

It is again rather interesting to note that the greatest error was obtained on the 24-hr rotation chart, which contained the most compressed record. This again demonstrated how accuracy in interpretation is increased when the time base of the instantaneous flow-rate is expanded.

In this first series of tests, the general agreement between the theoretical flow, 1-hr rotation charts, and the continuously integrating meter varied from what might be considered fair to excellent. However, the values obtained from the latter were generally more accurate; and on the basis of this, it was decided to use readings obtained from this meter as basis for comparison by the well-flowing tests.

Test VI to XI (series II) were conducted with actual wells flowing and were run to determine the magnitude of error that normally could be expected in day-to-day measurements of gas in obtaining gas-oil ratios of wells. Under these circumstances, it was not possible to obtain theoretical values for comparative purposes; and, on the basis of Series I tests, the results obtained by the continuously integrating meter were used as the datum.

Tests VI and VII were taken by engineering personnel observing experimental procedures and precautions, whereas Tests VIII through XI were run by the switcher of the lease and were meant to be representative of normal field operations. All tests in this series were recorded on a 24-hr rotation chart and the continuous integrating meter, to obtain representative data for actual well-flowing conditions. In addition to this, during Tests VI and VII, 1-hr rotation charts were taken consecutively during the flowing period to provide basis for further evaluation.

The error obtained from this series of tests by use of conventional methods, i.e., 24-hr chart rotation, varied from —6.72 to +2.34%. It is evident from inspection of the 24-hr charts (reproduced in *Fig. 7, 8, 9*) that the person integrating this type of record must estimate an approximate average differential which is most difficult to do, as a result of the square root function of the differential-flow relationship. Actually then, the value obtained under these circumstances, which to a greater or lesser degree exist in practically all well-test charts, is based to some extent on the skill and judgment of the integrator operator.

Although the number of tests run in the foregoing series was limited, of significance is the range of errors obtained, which is probably indicative of the error which may be expected in the average chart taken for gas-oil ratio determination. The error would appear to be more consistently on the negative side, which is probably the result of the manner in which the flow took place. Inspection of the records produced on the 1-hr rotation charts plainly shows the "heading" of the well, where the sustained flow is at the high rate, with intermittent decreases to some lower

TABLE 7. Computation Data—Hobbs Integration, Conventional Meter—1-Hour Clock, Test VII—Well Flowing Test

Test VII	Differential Pressure: Planimeter Rdg.	Differential Pressure: Average	Differential Pressure: 20-in. Extension	Static Pressure: Planimeter Rdg.	Static Pressure: Average	Static Pr. Extension	Combined Extension Factor	Meter Constant	Meas. Flow Conv. Meter	Meas. Flow Cont. Integ.	Conv. Meter Percent Error
Chart #1	4.185										
	4.124			6.970			11.40	1809	20,623*		
	4.163	4.157	3.46	7.005	6.988	24.4					
2	4.521			6.941							
	4.529	4.525	4.10	6.933	6.937	24.1	12.37	1809	22,377*		
									43,000*	43,080	—0.19*
3	4.529			6.952							
	4.522	4.526	4.10	6.962	6.957	24.2	12.39	1809	22,414	22,270	+0.64
4	4.836			6.995							
	4.772	4.804	4.62	6.987	6.991	24.4	13.16	1809	23,806	24,010	—0.85
5	4.915			7.041							
	4.907	4.911	4.82	7.019	7.030	24.7	13.52	1809	24,458	24,310	+0.61
						Total Flow Test Results			113,678	113,670	+0.01

*Continuously integrating meter reading not taken at end of first hour. Error based on two hours flow.

value. This characteristic was, of course, not evident on the 24-hr rotation chart and consequently could not be considered by the integrator operator.

The results obtained by use of the high-speed charts again corresponded very closely with those of the continuously integrating meter. The total flow for each test, obtained by the summation of the 1-hr charts, had a maximum deviation of —0.33 and +0.86%. The error on the individual charts was somewhat higher, but of the same order of magnitude and was probably the result of inability to follow the charts precisely.

Throughout this investigation, it became evident that one of the major sources of error in conventional methods was the manner in which the differential pressures were recorded. If the data are obscure, probable error is indicated. Generally, accuracy can be increased by use of a high-speed chart, but care should be taken to insure proper meter application. Basically, the response rate of the meter should be adequate for the frequency of the flow variations encountered. Work done subsequent to these tests has shown that in the Wasson Field, the time period of variation can be as low as 2½ seconds. Mercury-type instruments would be inadequate to follow this frequency, and certainly the practice of damping should be critically reviewed in dry-type meters, inasmuch as this rate is very close to the limits of some commercial meters of the bellows type.

One of the limiting factors to the use of high-speed circular charts for routine daily operations is the comparatively short time interval covered by each chart. This results in excessive requirements of man hours for chart changing and is not applicable to continuous operations. A high-speed strip-type recorder is one possible solution to this, which would keep instrument complication, cost, and practice at its present level. Either of these approaches, however, is subject to human error, and to obtain best accuracies special effort must be repeated with each measurement. This is time-consuming and, consequently, expensive.

The consistency and accuracy which can be obtained with a continuously integrating flow meter with automatic pressure compensation was effectively established, but it should be pointed out that data on long-term unattended application are limited, although encouraging. The advantage of a continuously integrating meter, which is common to most automatic devices, is that accuracy is constructed into the mechanism, and, once accurately calibrated, is independent of human limitations. Elimination of chart handling and integrating would be an economic consideration, particularly if complete elimination of this routine in operations could be established.

The disadvantages of this type of meter are their present high cost, and increased complication of construction. The present cost of this type of instrument is in the neighborhood of $1000, but this may be reduced somewhat, if increased application permits large-scale manufacture. The added complication of construction would require maintenance men of somewhat higher technical background, but no more so than what is currently required for many strip-chart electronic recorders now in use in many industries. Another consideration, which must be resolved, is the motive power available where this type of instrument is to be applied. Where electric power is either not available or undesirable, resort may be made to gas-driven mechanisms; and this is the course being followed by at least one major instrument manufacturer.

Probably the initial application of the continuously integrating meter with pressure compensation will be in those situations where greatest benefit can be derived, either from their increased accuracy in difficult metering applications or their ability to convert instantaneous flow rates to their finalized form of standard cubic feet of gas. In the intermittent gas lifting of wells the metering of gas is generally a difficult problem. Here the gas flow rate varies periodically from zero to some value possibly 75% of full scale. In the metering of gas produced from oil wells the increased accuracy may be of considerable importance and have considerable bearing on allowable oil production, prediction as to future workover requirements, and the evaluation of the success of remedial work. Similarly, inspection of charts obtained in metering lease gas sales may indicate that in certain leases accuracy could be increased by use of continuously integrating meters. Gas compressor outputs have long been notorious as a difficult metering problem, and application of this type of instrument would certainly bear investigation.

The general trend toward automation further emphasizes the need for a flow meter, the output of which is in the finalized form of standard cubic feet of gas. Once reduced to this form, the data can be readily converted to a code system for transmitting to remote locations. This is a basic requirement that must be met before full realization of the labor savings offered by this type of operation can be made.

The following generalizations based on the data obtained in this investigation are indicated: If the conventional method is used for gas flow measurement in oil-well testing, a source of error which should be critically examined is the type of chart produced. The chart speed of rotation should be sufficiently high to produce a record which is both distinct and explicit, because errors of considerable magnitude may be introduced by ambiguous records. The continuously integrating meter with automatic pressure compensation is capable of accurately measuring these flows and, if used, will introduce maximum errors of ±1.5%. Although the continuously integrating meter used in this investigation was electronic, it is believed that the general method has been proved accurate, and that other instruments using different techniques to obtain continuous integration, can produce similar results.

Conclusions

1. The use of continuously integrating meters with automatic pressure compensation in measuring the gas produced during the normal flowing of oil wells in the Wasson Field, should make it possible to obtain more accurate measurements.

2. In the conventional method the introduction of error is primarily the result of producing illegible records of instantaneous differential pressures.

3. Errors on actual well-flowing tests ranged from —6.72% to +2.34% with conventional methods. These are believed to be representative of average results obtained in normal operations.

4. The use of high-speed charts considerably improves the accuracy of the conventional method. Accuracies of the order of ±3% can normally be expected with this method, in addition to a much greater consistency of interpretation.

5. Where feasible the use of 6, 8, 10, or 12-hr rotation chart where 24-hr rotation charts are currently used should be seriously considered in daily operations.

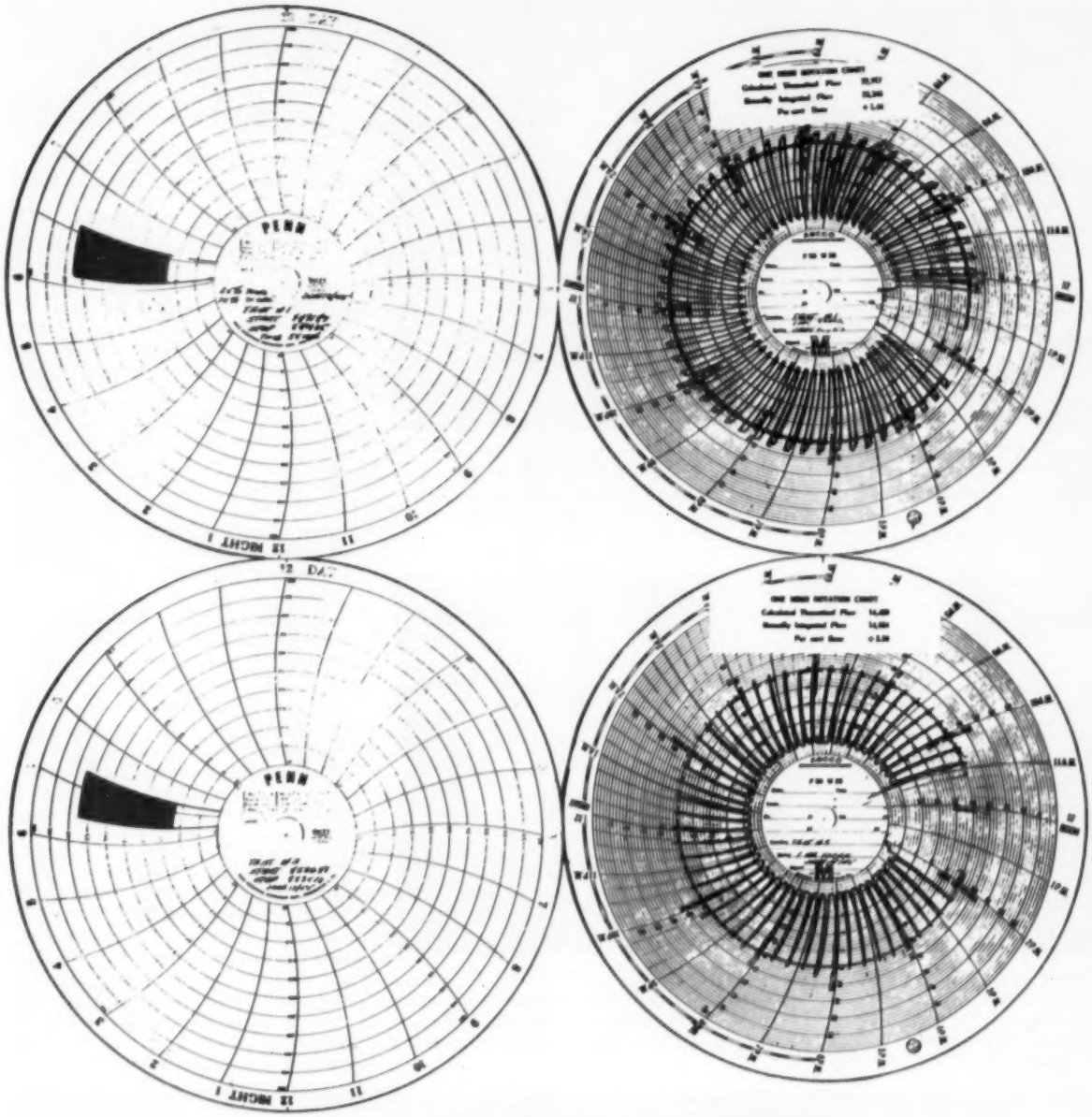


Fig. 10. Tests VIII, IX, X and XI well flowing tests, 24-hr rotation charts.

6. The electronic continuously integrating flow meter with automatic pressure compensation proved superior to the conventional method in accuracies obtained. Maximum errors ranged from —1.60 to +0.31% under the most severe conditions.

7. In this investigation the rate of response of the electronic meter proved faster, which is of primary importance in metering fluctuating flows. This feature was not established as a basic characteristic of the type of meter, but could logically be caused by absence of load on the bellows when used in conjunction with electronic meters.

8. Other advantages resulting from the continuous integration are: (A) elimination of secondary handling of charts for computation purposes; (B) immediate availability of results; (C) adaptability of output of the meter to remote transmission; and (D) elimination of the human element. ■

This article was adapted from a paper presented at the spring meeting of the API division of production, March 21-23, 1956, at Fort Worth, Texas. The paper was presented by Mr. Pogontcheff under the title "Investigation of a continuously integrating flow meter for gas measurements."

GAS

Although this article is based on investigation and research conducted by a company in the field of gas production, the subject of gas measurement is one that will be of paramount interest to distribution and transmission measurement engineers as well. In future issues of GAS, other types of integrating flow meters will be discussed in detail.

F. H. Bunnell (left), Consumers Power Co., Jackson, Mich., chairman of the AGA Distribution Committee, welcomes James F. Oates Jr., chairman of Peoples Gas Light & Coke Co., Chicago, to the recent Distribution, Motor Vehicles and Corrosion Conference in Chicago. Looking on is V. F. Bittner of Peoples Gas, second vice chairman of the AGA's Operating Section, which sponsored the conference.

Featured speakers at the distribution design and development session at the AGA Distribution, Motor Vehicle and Corrosion Conference included (left to right): Mike Anuskiewicz Jr. (Brooklyn Union Gas Co.), P. B. Thompson (Michigan Consolidated Gas Co., Detroit), D. K. Ruth (Manufacturers Light & Heat Co., Pittsburgh, Pa.), and L. C. Rohret (Middle West Service Co., Chicago).

GAS ASSOCIATIONS

Transmission, distribution men hear varied programs

Topics ranging from automation in nearly every phase of the gas industry to discussions on cutting costs in the operation of motor vehicles took the spotlight in Chicago last month as the AGA's Operating Division held its annual Distribution, Motor Vehicles and Corrosion and Gas Supply, Transmission and Storage Conferences.

The four-day distribution conference, which started May 7, came first. This was followed by the two-day transmission conference on May 10.

The trend toward more extensive use of telemetering, electronic computers and automatic controls was brought out in many sessions of both conferences.

Along the line of automatic controls, Paul A. Manor of Rockwell Manufacturing Co.'s Barbeton division presented a paper on "Automation and the Lubricated Plug Valve." In this paper, Mr. Manor pointed out that lubricated plug valves first went into use 40 years ago. During the intervening years, engineering advancements have produced an automatic valve now used in many distribution systems.

Taking part in the corrosion session of the AGA Distribution, Motor Vehicle and Corrosion conference were N. P. Peifer (Manufacturers Light & Heat), chairman of the AGA corrosion committee; A. J. Liebman (Pitmer Centrifugal Machine Corp.), S. J. Bellassai, (Transcontinental Gas Pipe Line), John B. DiRienzo (Public Service Electric), and J. J. Meany Jr. (A. V. Smith Engineering).

Ruud has everything!

Ruud has the product and the promotion to help you sell more gas water heaters. It's the line that wins and *holds* customers. It's a complete, *full-coverage* line of both residential and commercial water heaters. One line to learn, stock, advertise, promote and sell. One complete line for a simplified, streamlined water heater program that will do the *big* job for you.

Ruud has water heaters of all types, sizes and prices . . . for all gases, water conditions and hot water demands. Models with Enameline ("glass-lined"), Monel or Alcoa® Alloy non-ferrous, rust-proof, long-life storage tanks. Ruud Laundry-Rated* models to match the demand of any automatic clothes-washer made. Models with greater gas input to deliver greater hot water output, so necessary for modern home needs—and all this without increased tank size.

Ruud has two-temperature water heaters for residential use that simultaneously provide 180° water for the automatic clothes-washer and dish-washer—125° water for other household needs. Water heaters for commercial use that simultaneously provide 180° water for dish-washers and 140° water for other general-purpose demands.

All these are RUUD—the magic selling word in automatic GAS Water Heaters.

*Trademark

® Aluminum Co. of America

RUUD GAS WATER HEATERS

Kalamazoo 24, Michigan • Toronto 14, Ontario

RUUD IS THE UPGRADED LINE

Ruud Water Heaters are upgraded to conform with Point No. 7 of the American Gas Association's Gas Industry Action Plan. They're upgraded so that the number one advantage of gas—SPEED—is fully capitalized. Upgraded . . . so that users get more hot water without increased tank size. *Upgraded . . .* to assure the gas utility of *full revenue* from every customer.

Mail the coupon so your Ruud representative can show you the big, new Ruud *Full-Coverage* Portfolio.

Get the new, big Ruud story. Fill out and mail the coupon below—today!

MAIL THIS COUPON TODAY

RUUD MANUFACTURING COMPANY
2025 Factory Street, Kalamazoo 24, Michigan—B-1

☐ Send me further information on the new "Ruud-has-everything" line.

☐ Have a Ruud representative show me the new Ruud Full-Coverage Portfolio.

NAME _____ POSITION _____

BUSINESS NAME _____

BUSINESS ADDRESS _____

CITY _____ ZONE ____ STATE _____

SOLD
to the women of America
looking for cooking miracles
OFF
LO 150
200
250
300
350
400
HI

SOLD

because automatic top-burner control gives your customers a new, irresistible kind of cooking freedom!

SOLD

because automatic top-burner control gives YOU a new, irresistible kind of sales story!

Looking for Selling Miracles?

Feature gas ranges equipped with automatic top-burner cooking controls

SHOW how heat in pan controls the flame and assures perfect cooking results.

SHOW why foods can't burn, over-cook, boil over... can't smoke or burn onto utensils.

SHOW that automatic top-burner control makes every cooking utensil automatic.

Manufacturers: The big sales push is on at the retail level. Everybody is promoting ranges equipped with automatic top-burner controls!

Gas Companies: Build better acceptance among your customers for gas ranges and gas, the modern, automatic cooking fuel.

Range Dealers: Move in strong on the big buying surge for automatic top-burner cookery. Sales-appeal plus ... and for higher-priced models, too!

Robertshaw-Fulton

CONTROLS COMPANY

Robertshaw Thermostat Division, Youngwood, Pennsylvania

Robertshaw-Fulton Controls (Canada) Ltd., Toronto

Help for you in selling higher-profit gas ranges: "More Income For Gas Range Salesmen" — new 20-page sales-training booklet on how to demonstrate and sell automatic top-burner control. Free! As many as you can use!

Help for you at the consumer level: 13 brand new half-hour TV films on top-burner cooking, starring Dione Lucas. Soon to be released through Gas Companies coast to coast.

An open forum on computer and analyzer studies, moderated by J. P. Clennon, Peoples Gas Light & Coke Co., Chicago, with B. E. Hunt, Illinois Power Co., Decatur, Ill., and H. B. Woodward, Ohio Fuel Gas Co., Columbus, Ohio, brought out many different applications of computers among distribution companies.

Automation and telemetering in gas transmission was pointed up in the transmission conference during a session on "Practical Application of Telemetering and Supervisory Control Equipment." Topics discussed included "Systems Planning and Application," T. G. Humphreys, Alabama Gas Corp., Birmingham; "Basic Telemetering and Control Equipment," W. E. Rufleth, Bristol Co., Waterbury, Conn.; "Systems Engineering," Control Corp., Minneapolis, Minn., and "Designing Safety and Reliability Into Remote Facilities for the Natural Gas Industry," Edwin D. Nuttall, United Gas Corp., Shreveport, La.

Officials of the AGA Gas Supply, Transmission & Corrosion conference pause for a moment during the recent session in Chicago. Shown here (l to r): J. H. Collins Sr. (New Orleans Public Service), chairman, AGA operating section; Grove Lawrence (SoCal), operating section vice chairman; D. B. Sprow (Natural Gas Pipeline Co.), transmission committee chairman, and H. L. Freuchtenicht Jr. (Michigan Gas Storage), chairman, underground storage committee statistics subcommittee.

General and special sessions of both conferences touched on nearly all phases of gas distribution and transmission.

SGA alerted to confusion between growth, expansion

While stressing the amazing growth of America as offering a fertile field for expansion of the natural gas industry, speakers at the recent Dallas convention of the Southern Gas Association cautioned against confusing normal growth with expansion and progress.

Delegates were told of the need for a sound, united public relations program to bring home to the public the service the industry performs.

Members of SGA closed the biggest convention in the association's 48-year history with the election of Richard A. Puryear Jr., new head of Alabama Gas Corp., to the presidency of the group. For the first time, registration of delegates topped the 2000 mark, reaching 2035.

From the speaker's platform, Dean Lawrence C. Lockley of the University

MAXITROL UPGRADING PROGRAM
improves gas regulators

While Maxine is on vacation this month, Maxitrol engineers are back at work, bringing you the results of the new upgrading program—offering you greater sensitivity, greater stability on

RV-42—For central household heating. Completely new. Bigger capacity: 126,000 Btu/hr., certified under new A. G. A. requirements. (Replaces **RV-40**).

RV-81, RV-91—More sensitive, more stable, more regulation for the money. Improved performance at inlet pressures up to 5 psi. (Replace **RV-80** and **RV-90**).

SEE THEM ALL IN THE BRAND NEW MAXITROL CATALOG. SEND FOR YOUR FREE COPY.

MAXITROL COMPANY

12200 BEECH ROAD • DETROIT 39, MICH.
Originators Of *"STRAIGHT-THRU-FLOW"*

the new, versatile BASO®

Valve No. 871

DEPENDABLE BASO VALVE PROVIDES COMPLETE SHUT-OFF WITH AUTOMATIC OR MANUAL CONTROL

Install it on floor furnaces or room heaters. Used either as a manual control or installed downstream from an automatic main gas valve, the Type 871 provides complete shut-off of main burner and pilot gas. Safe lighting, too, is a feature with either kind of installation.

Baso valve No. 871 is simple to install and service. Power unit is replaceable. Pilot gas is adjustable.

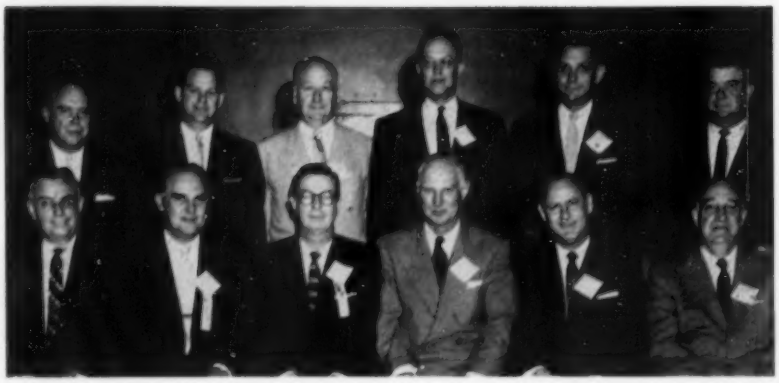
Type 871 is designed for use with all fuel gases. The valve body is cast aluminum alloy; internal parts, in contact with gas, are stainless steel and aluminum so that manufactured, natural, or liquefied petroleum can be used. Size is ½", providing a capacity of 80,000 Btu. per hour with manufactured gas. Write for Bulletin.

MILWAUKEE GAS SPECIALTY CO.
Dept. SC-12
MILWAUKEE 1, WISCONSIN

of Southern California's School of Commerce told attendants there is no such thing as market saturation in our present economy.

"The growth of the market and the pace of obsolescence increase demand no matter how rapidly we sell wanted appliances," Dean Lockley said. "Sales and profits can be as large as we choose to make them."

He predicted that by 1976 our standard of living will be double what it is today, with population of 210 to 215 million, jobs for 86 to 89 million, and a gross national product of between $700 and $800 billion.



Newly elected officers and directors of the Southern Gas Association. Standing, left to right: Minor C. Sumners, director; Dale E. Frieden, secretary; W. R. McLaughlin, director; E. Clyde McGraw, director; Kyle H. Turner, assistant secretary; Paul F. Falk, director. Seated, left to right: Carl E. Cloud, second vice president; Curtis M. Smith, first vice president; R. A. Puryear Jr., president; A. H. Weyland, chairman of advisory council; James A. Davis, vice chairman of advisory council; and Willard G. Wiegel, treasurer. This photograph does not include Earl J. Newlin, director, and John F. Forsyth, director.

"The one handicap to rapid development of household appliance markets is in the appliance industry itself, grown fat and lazy during these years of lush consumer demand," Dean Lockley warned. "The sales will go to those manufacturers, those utilities, and those dealers who are willing to sell."

AGA President Dean Mitchell cautioned that there is a pressing need for unity in the industry.

"We have never been able to adequately capture the imagination of the American people," he said. "The politicians, our public relations barometer, still believe a slightly anti-utility attitude has popular appeal. To me, the tragedy was not the passage or lack of passage of the Harris-Fulbright bill, however much it may have been needed. The tragedy was the display and existence of a divided industry. Out of our soundest thinking must be found a way to unity. No segment of our industry can go it alone."

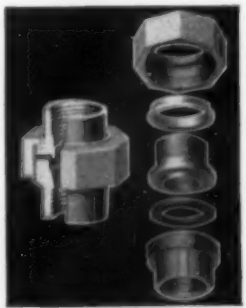
"The time is long past when an industry can afford to look at public relations as either a necessary evil or a tolerated luxury," advised Henry Obermeyer, administrative vice president of Bozell & Jacobs and a long-time leader in gas industry advertising programs. "It actually is as much of an operating problem as accounting, personnel and purchasing, and only slightly secondary, perhaps, to distribution. Every

New CRANE
¾-inch
Safety Vent Elbow
with non-clogging screen

Here's a basic improvement in gas vent elbows. A flexible stainless steel coil spring takes the place of the old bar grate or rigid screen that clogged so easily. In normal, or closed position, the space between the windings of the coil spring is small enough to keep out insects, dirt, etc. But gas pressure from behind easily flexes the spring outward, enlarging the space between coils for full-open venting of gas and the expulsion of foreign matter.

Durable, dependable—die cast of zinc alloy with integrally cast cross bar to prevent the coil spring from being jammed back into the fitting. *Thousands already in service.*

Check your Crane Representative on both these new items!



New
CRANE Insulated Union
Gives Cathodic protection at meters

Install this new insulated union at the gas meter for cathodic protection against galvanic corrosion. Special gasket and washer with high dielectric strength effectively break the electric path. Regular ¼-inch size in Crane malleable iron.

CRANE

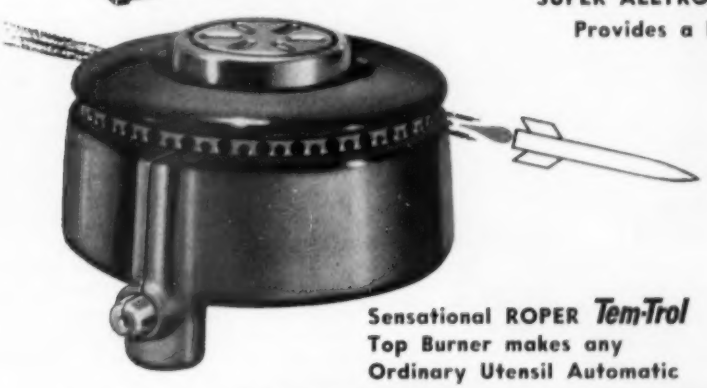
CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

ROPER

"America's Finest GAS Range"

Brings You Best Cooking Top PERFORMANCE in the Entire Market!



SUPER ALLTROL "CENTER-SIMMER" TOP BURNER
Provides a heat speed for every cooking need

Sensational ROPER *Tem-Trol* Top Burner makes any Ordinary Utensil Automatic

NEW! Revolutionary *ROCKET-SPEED* Burner!

FASTEST in the Market (gas or electric)

Here it is! The very ultimate in cooking speed. Terrifically fast. Giant size. Remarkably flexible . . . from giant, rushing flames down to "Keep-Warm" flame. It's an exclusive from Roper, for competitive selling.

Now! Roper scores a new high in top-of-range speed and performance. No other cooking top is so efficient . . . so convenient.

GEO. D. ROPER CORPORATION • Rockford, Ill.

Geo. D. Roper Corporation
Rockford, Illinois **G656**

Sounds wonderful! Rush me details about the new Roper "Rocket-Speed" top burner.

Firm Name _____

Individual _____

Address _____

City _____ State _____

company has public relations, whether it wants it or not, and it can choose only whether it's to be good or bad."

At the close of the convention, SGA President Puryear announced that the association's series of round-table conferences for 1956-57 will include, for the first time, two on public relations, held in cooperation with AGA.

In his approach to the expansion challenge, AGA's managing director, C. S. Stackpole, pointed out that "Bigger families, better-eating families, quality-minded and style-conscious families are creating an enormous new market for kitchen ranges," and it's up to the natural gas industry to let "Mama" know that gas is best for cooking.

Some of his reasons for the increasing market for home appliances were: (1) More and more people are substantial income people. "Mama" is demanding quality, and the heck with price. (2) Modern kitchen equipment has social prestige. "Mama" is proud of her kitchen and wants to show it off. (3) With more children being born in the average family, "Mama" needs bigger ranges and other appliances. (4) "Mama's" family is eating better than ever because she's spending more money on more nutritious food. (5) "Mama" is demanding more kitchen-free hours and is eager to learn about the automatic features of the modern gas range in terms of what they will do for her.

Other new SGA officers are Curtis M. Smith, Tennessee Gas Transmission Co., Houston, first vice president; Carl E. Cloud, MidSouth Gas Co., Little Rock, Ark., second vice president; A. H. Weyland, Arkansas Louisiana Gas Co., Shreveport, chairman, and James A. Davis, Empire Southern Gas Co., Fort Worth, vice chairman, advisory council; Dale E. Frieden, Zenith Gas System Inc., Alva, Okla., secretary; Kyle H. Turner, Atlanta (Ga.) Gas Light Co., assistant secretary; and Willard G. Wiegel, Lone Star Gas Co., Dallas, treasurer.

Weymouth, industry pioneer, honored at short course

Honored guest speaker at the opening session of the 31st Southwestern Gas Measurement short course was Thomas R. Weymouth, pioneer natural gas engineer and executive. Mr. Weymouth developed the first orifice meter for measuring gas. During the 1920's he was president of Oklahoma Natural Gas Co. Now retired, he also is a former president of the Iroquois Gas Corp., Buffalo, N. Y., and former vice president of the Columbia Engineering Corp.

Principal speaker Tuesday at the general session was Chester S. Stackpole, managing director of the American Gas Association, New York City.

Approximately 950 men from the industry registered for the short course held on the campus of the University of Oklahoma. One of the features of

Thomas R. Weymouth (right), pioneer natural gas engineer, chats with Chester S. Stackpole, managing director of the AGA, at the annual gas measurement short course on University of Oklahoma's campus.

a quality plus "tool"

for burning all kinds of GAS

WEBSTER KINETIC®

At no extra cost to you this burner now is furnished with a venturi tube and flame retention nozzle fabricated from *heavy gauge* steel. Longer life and smoother operation is assured from a lighter weight unit.

The heavy gauge chrome alloy nozzle is also standardized on the ROTONETIC and HC DYNETIC

This is just another example of Webster's ability to engineer and manufacture a more efficient and economical "tool" for burning gas. In its class no other commercial or industrial burner can compare cost wise with quality.

The WEBSTER ENGINEERING *Company*

TULSA 1, OKLAHOMA

Division of SURFACE COMBUSTION CORPORATION, Toledo, Ohio

BEST TOGETHER

best gas odorant—best odorant service

Alert "80"

Best economy-priced, quality mercaptan

Alert "80" has been proved in all types of distribution systems, has met every test by large and small utilities. It is a selected and blended group of mercaptans with precision blending and balancing—giving better, full range volatility and stronger initial "punch."

Calodorant "C"

Best quality sulfide type odorant

Calodorant "C" is the only natural gas odorant in use that is completely stable in high pressure lines—1000 psi or more—and at low temperatures—0° F or lower. It is equally effective at medium and low pressures in either transmission or distribution systems—large or small.

Specialists in odorization problems!

Since marketing of the first gas odorant in 1927, Oronite has been a major producer and leader in the field. Ask Oronite about any problem you may have—chances are we have already done the research and have the answer.

Oronite Odorometer

Provides the simplest way to test odor intensities in your distribution system. Ask for a demonstration by contacting the Oronite office nearest you.

ORONITE CHEMICAL COMPANY

EXECUTIVE OFFICES: 200 Bush Street, San Francisco 20, California

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450 Mission Street, San Francisco 5, Calif. — 714 W. Olympic Blvd., Los Angeles 15, Calif.
30 Rockefeller Plaza, New York 20, N. Y. — 20 North Wacker Drive, Chicago 6, Illinois
Carew Tower, Cincinnati 2, Ohio — Mercantile Securities Bldg., Dallas 1, Texas
36 Avenue William-Favre, Geneva, Switzerland

ORONITE CHEMICAL COMPANY

the course was a display of educational equipment used in the measurement of gas.

Continuous redesign of appliances called for

There is a constant need to redesign even the most modern gas appliances to keep up with modern living trends, attendants were told at the 29th annual session of the Mid-West regional gas sales conference. Speaking was Robert L. Brookman, Ruud-Humphrey Sales Co., Chicago, who said expanding uses in present day living demand new designs. The 95 million population estimated for 1966 will demand 40% more production than this year's level.

Redesign creates new and additional demand and desire for products, Mr. Brookman said. Industry must redesign for survival.

As an example, Mr. Brookman pointed to the danger to the domestic hot water load from the hot water laundry demand. Manufacturers of automatic water heaters must redesign to keep ahead of competition which claims it can take over at any time. Electric competitors are redesigning units to overcome advantages previously held by gas. Gas hot water heater manufacturers also must redesign, he said, to increase revenue and income. The industry now is losing revenue to 6 million electric heaters presently in use, plus an unknown number of coal and oil heaters.

More than 300 delegates from gas utility and gas appliance manufacturers attended the three-day conference which is sponsored by residential gas section of the American Gas Association.

such even thickness in diaphragm leather

Once again, Lancaster leads in meter diaphragm improvement for better meter performance. Not only is the finest quality lambskin used exclusively, but we are now able to furnish leather of consistently more even thickness on both sides and across the entire diaphragm.

The even thickness, flexibility and non-shrinkable leather used in Lancaster groove type metal rim diaphragms assure greater accuracy and less wear on other parts. It is another reason why Lancaster diaphragms cost you less in the long run.

Send for a sample and see for yourself.

Lancaster METER PARTS CO.
POST OFFICE BOX 376 LANCASTER, OHIO

Accountants' conference stresses cost reduction

Cost reduction through improved accounting measures was the theme of the National Conference of Electric and Gas Utility Accountants held in New York. More than 1200 delegates — a record attendance—were present at the meeting jointly sponsored by the AGA accounting section and the accounting division of the Edison Electric Institute.

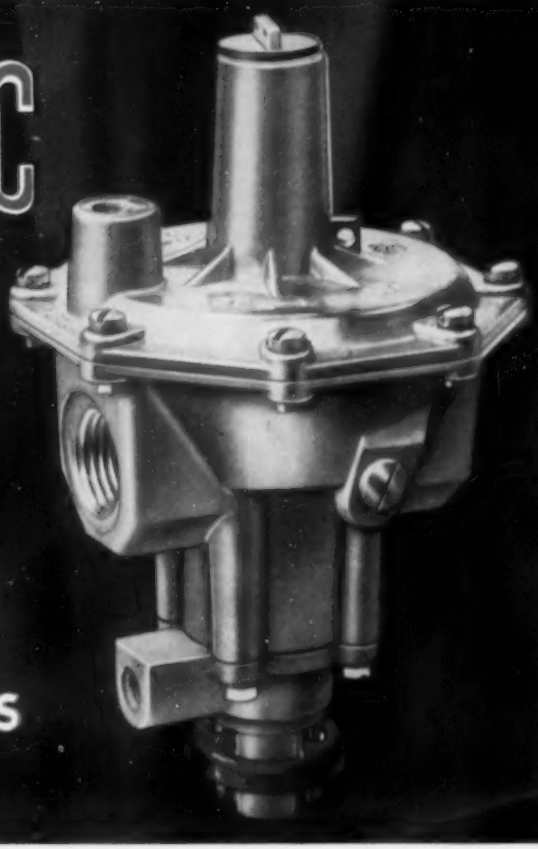
Edwin Vennard, vice president of EEI, pointed out utilities were industries of heavy investment. To increase returns and attract added investment, utilities would have to increase sales or cut costs, or do both. With no reflection on the importance of increased sales, he pointed out that $1 saved in expense was equal to about $4 in increased business. Both are needed in the industry.

The great cost of preparing and filing correspondence and reports by American business was the subject of a talk by Emmet J. Leahy, management consultant. He said the nation's office workers turned out more than 175 billion pieces of paper annually. Pipeline companies can transport a gallon of oil more than a thousand miles for a penny, tankers can carry oil from Texas to Maine for a penny a gallon, but it costs a minimum of a penny to keep a single piece of paper in office files for one year.

Regulation is a living thing, Judge H. Lester Hooker, Virginia State Corporation commissioner, told the accountants. It is not static, and there is no rule-of-thumb method or formula in regulation that is not subject to change. If regulation did not change to meet the inflationary conditions that have been and are now existing, it would not be operating in the public interest. It would become static and disappear, Judge Hooker said.

It is the duty of all regulatory commissions to exert their best efforts to keep all utilities in a sound financial situation, he said. This is essential in

THERMAC



Finest
GAS CONTROLS

What the name THERMAC on a gas control means to you . . .

Undivided attention to the specialty of producing gas controls has resulted in a number of basic and substantial design features around which our present products are built.

Concentration too, in manufacturing and production methods is also vitally important. In our own modern plant we do the entire job from Engineering and Research to Assembly and Final Testing — no one else is entrusted with this responsibility. Therefore, the controls you buy today are the result of 24 years of highly concentrated effort in research and in manufacturing techniques. Our volume production methods are your assurance of low cost.

Sound engineering, expert manufacturing, low cost and prompt delivery — that's what the name Thermac means to American Appliance Builders.

SEND FOR ILLUSTRATED CATALOG

24 YEARS' EXPERIENCE BUILDING GAS CONTROLS

THERMAC

Service is our job — on the spot engineering assistance and immediate delivery.

HM COMPANY 800 East 108th Street • Los Angeles 59, California

order for them to expand their business so they can adequately meet the demands for service required by the public.

Intensive selling needed, management conference told

Two minor recessions in the past decade — in 1948-1949 and in 1952-1953—lowered gross national production about 5%, but present recovery has lifted production 11%, according to George W. Mitchell, Federal Reserve Bank of Chicago, who addressed the recent AGA general management section meeting in Chicago. Overall postwar growth of national production is about 4.1%, he said.

Stocks of durable goods at present are fairly high, Mr. Mitchell told the 260 representatives of nearly every branch of the gas industry in attendance. And, some intensive selling is needed to persuade consumer purchasing. He predicted that favorable conditions were ahead for the gas industry, although retail sales in general fell slightly in the past two months.

Dean H. Mitchell, president, Northern Indiana Public Service Co. and AGA president, congratulates Chairman John H. Carson (right) on effective general management section conference.

Different areas of human behavior were discussed by A. C. VanDusen, vice president and director of public relations, Northwestern University, who pointed out to management that most employees, in all types of positions, feel the need for attention. Employees want to feel important and that they belong to the team. Praise is as important as criticism in securing best results from employees.

Martin Elliott, director of the Institute of Gas Technology, speaking on the difficulty in getting and training gas engineers, pointed out that more than 40 gas engineers are needed in the industry each year, but only 23 (of all types) were graduated last year. He advocated that gas companies, through scholarships and other means, aid in recruiting students at the undergraduate level for advance work in gas engineering.

The Canadian gas picture was discussed by Dr. George W. Govier, head of the department of chemical and petroleum engineering at the University of Alberta.

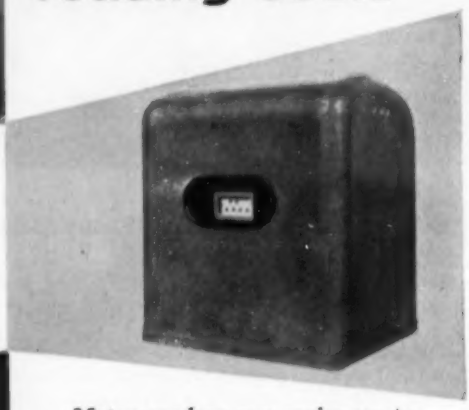
He said that in the past two or three years, 800 to 1200 development wells and 350 to 400 wildcat wells had been drilling annually. The great bulk of these were oil wells due to the relatively strong market for Alberta oil and the lack of pipelines to large markets for gas. However, he said, out of every 100 wildcat wells, about 13 or 14 have been oil strikes and 19 or 20 have been gas strikes.

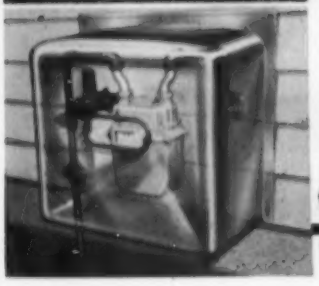
Existing established reserves in Alberta in 1954 were 13.4 trillion cu ft. Present reserve is approximately 16 trillion cu ft. Dr. Govier believes that the ultimate gas reserves in Alberta will exceed 100 trillion cu ft. Present consumption of gas is about 100 billion

Yard model (right) sits directly on ground, with no rot or corrosion danger. Can be fastened to stakes. Wall model (above) has slots in flange, slips over screws.

Meter Dome

solves housing problems, cuts reading costs





Meter readers can make up to twice as many calls per day when sets are outside, and protected by a genuine one-piece Fiberglas Meter Dome. Emergency shut-offs are quicker, servicing is easier, annual painting is unnecessary, and installations are more economical.

Get the complete story today on money-saving plastic Meter Dome. It's your best buy in the meter cover field.

Transparent models (left) show roominess of Meter Domes. Either one easily holds any size domestic meter, meter bar and regulator.

the Buckeye Supply Co.

18 HARRISON AVE. • ZANESVILLE, OHIO

Here-a year ahead of time

Advanced new 1957 **Servel**

MODEL 1179-G

Now! The world's only gas refrigerator becomes the world's most automatic refrigerator! This powerful new selling combination will be boosting gas loads and profits for Utilities and Dealers coast-to-coast this year!

The amazing 1957 Servel outmodes, outdates, *obsoletes* every other refrigerator! Makes and serves ice cubes *automatically!* Defrosts *automatically!* Controls temperature *automatically!* Add powerful features like 10 year warranty on the refrigerating unit, silent dependable operation (out of the 4,000,000 Servels sold, 3,500,000 are still in use!) and you've still only *begun* to hint at the appeal of this big new beauty! It has...

- **Exciting color-balanced styling!**
- **"Air Conditioned" cold, no more dried-out foods!**
- **Adjustable roll-out shelves!**
- **Huge 70-lb. full-width deep cold freezer!**
- **Removable Serv-A-Tray for carrying foods from Servel to table!**
- **Removable trays for 3 dozen eggs!**
- **80 lbs. extra steel for extra quality!**

New Utility Dealer Support Plan Booms Gas Refrigerator Sales!

By offering Dealers Free installation, Free Service, No recourse financing, Gas Companies have had amazing success recruiting new Dealers, boosting refrigerator sales—and as a result, boosting their gas loads!

Pittsburgh has reported 414% sales increase, 35 new Dealers! Boston-Worcester has reported sales up 51%, 42 new Dealers! Dallas-Ft. Worth has reported a sales increase of 94% and 13 new Dealers!

It's a profitable plan for any Utility! Surveys show a gas refrigerator increases gas load profits up to 200% *per residential customer!* No wonder Gas Companies everywhere are adopting such a plan. Let us tell *you* about it!

The name to watch for great advances in REFRIGERATION AND AIR CONDITIONING

Servel

Servel boosts summer loads with both gas refrigeration and air conditioning

Servel Inc., Evansville 20, Ind. In Canada, Servel (Canada) Ltd., 548 King Street W., Toronto, Ont.

Ask Servel About The Sun Valley—The Answer To Your Residential Gas Cooling And Heating Problem.

cu ft/year for the entire province. Dr. Govier forecast that 400 billion cu ft/year could be exported by 1960 and by 1980 over 1100 billion ft per year.

Appliance men elect Klein to succeed Rockwell

Julius Klein, president of the Caloric Appliance Corp., Philadelphia, was elected president of the Gas Appliance Manufacturers Association during the 21st annual meeting of the trade group at White Sulphur Springs, W. Va.

Now second vice president of the association, Mr. Klein will take office as president in October, succeeding W. F. Rockwell Jr., president of the Rockwell Manufacturing Co., Pittsburgh.

Other newly elected officers are: first vice president, Clifford V. Coons, Rheem Manufacturing Co., New York; second vice president, E. A. Norman Jr., Norman Products Co., Columbus, Ohio; treasurer, Stanley H. Hobson, Geo. D. Roper Corp., Rockford, Ill.

Thirteen GAMA divisions also elected officers. The newly elected division chairmen, vice chairmen and executive committee members are as follows:

Domestic gas range division; chairman—Cecil M. Dunn, Magic Chef Inc., St. Louis; vice chairman — John P. Wright, Florence Stove Co., Chicago; executive committee member — Wendell C. Davis, Cribben & Sexton Co., Chicago.

Gas wall & floor furnace division; chairman —Harley Weatherley, Chattanooga (Tenn.) Royal Co.; vice chairman — Lyman Mac Harg, Williams Furnace Co., Buena Park, Calif.; executive committee member—Paul Hammond, Holly Manufacturing Co., Pasadena, Calif.

Gas conversion burner division; chairman —Robert I. Warneke, Roberts Gordon Appliance Corp., Buffalo; vice chairman—H. P. Mueller Jr., Mueller Climatrol Div., Worthington Corp., Milwaukee; executive committee member—E.P. Hayes, C. A. Olsen Manufacturing Co., Elyria, Ohio.

Gas valve division; chairman—Norman Reif, W. J. Schoenberger Co., Cleveland, Ohio; vice chairman—Howard Goss, Harper-Wyman Co., Chicago; executive committee member — Fred Schmidt, Roberts Brass Manufacturing Co., Mitchell, Ind.

Gas incinerator division; chairman—Don Winegardner, Majestic Co., Inc., Huntington, Ind.; vice chairman—William Hebert, Calcinator Corp., Bay City, Mich.; executive committee member — F. H. Martin, Martin Stamping & Stove Co., Huntsville, Ala.

Automatic controls division; Chairman—Karl Schick, Minneapolis-Honeywell Regulator Co., Minneapolis; vice chairman—E. B. Maire, Penn Controls Inc., Goshen, Ind.; executive committee members—Frank Post, Robertshaw-Fulton Controls Co., Greensburg, Pa.; F. G. McCloskey, Crise Controls Div. of Acro Manufacturing Co., Columbus, Ohio; D. J. Wood, Titan Valve & Manufacturing Co., Cleveland.

Gas unit heater & duct furnace division; chairman — T. D. Bromley, Gas Heating Div., Peerless Manufacturing Co., Louisville, Ky.; vice chairman—R. A. Bell, Surface Combustion Corp., Toledo; executive committee member—David Webster, Reznor Manufacturing Co., Mercer, Pa.

Gas appliance regulator division; chairman—Walter Lee, Major Controls, Corona, Calif.; vice chairman — Wayne Schutmaat, Penn Controls; executive commitee member—Frank Kern Jr., Maxitrol Co., Detroit.

Gas clothes dryer division; chairman—Franklin T. Grimes, Whirlpool-Seeger Corporation, St. Joseph, Mich.; vice chairman —Leroy Klein, Caloric Appliance Corp.; executive committee member — Norman Millard, Crosley-Bendix Home Appliance Div., Avco Manufacturing Co., Cincinnati.

Gas boiler division; chairman—Frank J. Nunlist, Mueller Climatrol Div., vice chairman—E. T. Selig Jr., Burnham Corporation, Irvington, N. Y.; executive committee mem-

Continued on page 88

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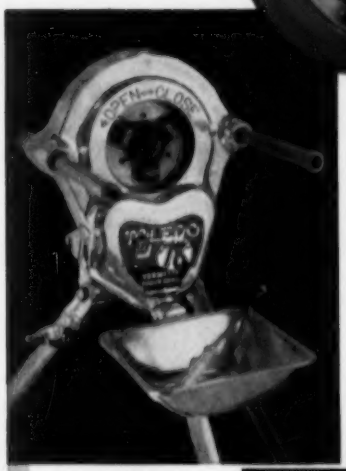
Get easy, accurate operation with this quality ratchet threader



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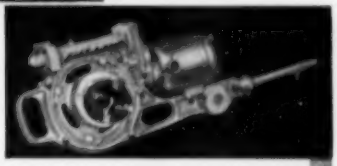

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* **Prevent regulator from falling in a wide open position, thus limiting the amount of gas the safety seal has to pass.**
* **Enable the gas company to set the regulator for a certain demand and if a customer increases that, his outlet pressure would drop which would cause him to call the company and they can find out what his real demands are.**

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GAS calendar

June

4-8..National Fire Protection Association 60th Annual Meeting—Hotel Statler, Boston.

5-6..PCGA Domestic Research & Utilization Conference—Ambassador Hotel, Los Angeles.

11-13..Appalachian Underground Corrosion Short Course—West Virginia University, Morgantown.

24-26..Wisconsin Utilities Association Accounting Section Convention—Schwartz Hotel, Elkhart Lake, Wis.

25-26..Michigan Gas Association—Grand Hotel, Mackinac Island, Mich.

26-29..Canadian Gas Association — Manoir Richelieu, Murray Bay, Quebec.

July

24-27..NARUC Annual Convention — Sheraton Palace Hotel, San Francisco.

August

27-29..16th Annual Appalachian Gas Measurement Short Course—West Virginia University, Morgantown.

September

7..New Jersey Gas Association Annual Meeting — Spring Lake, N. J.

11..NEGA Safety Conference—Hotel Statler, Boston.

11-13..Pacific Coast Gas Association Annual Meeting—Coronado, Calif.

12-14..Mid-West Gas Association Gas School and Conference — Iowa State College, Ames.

12-14..3rd Annual Electrical Conference of the Petroleum Industry (AIEE)—Kansas City, Mo.

14..NEGA Commercial-Heating-Industrial Division—Wachusett Country Club, West Boylston, Mass.

14-15..Maryland Utilities Association Fall Conference—Cavalier Hotel, Virginia Beach, Va.

18-19..AGA Accident Prevention Conference — Shirley-Savoy Hotel, Denver.

19-21..Southeastern Gas Association —Hotel Sir Walter, Raleigh, N. C.

October

15-17..AGA Annual Convention — Atlantic City, N. J.

22-26..National Safety Council — Chicago.

November

12-15..American Petroleum Institute —Conrad Hilton Hotel, Chicago.

1957

March

11-15..National Association of Corrosion Engineers—Kiel Auditorium, St. Louis, Mo.

18-21..MidWest Gas Association—Hotel Nicollet, Minneapolis.

21-22..New England Gas Association Annual Meeting—Hotel Statler, Boston.

28-29..Oklahoma Utilities Association Annual Convention — Tulsa.

April

8-10..National Conference of Electric and Gas Utility Accountants — Sheraton-Park Hotel, Washington, D. C.

8-11..GAMA Annual Meeting — The Greenbrier, White Sulphur Springs, W. Va.

8-11..AGA Distribution, Motor Vehicles and Corrosion Conference—Rice Hotel, Houston.

16-18..Southwestern Gas Measurement Short Course—College of Engineering, University of Oklahoma, Norman.

16-18..AGA Sales Conference on Industrial and Commercial Gas —Jung Hotel, New Orleans.

29-May 1..Southern Gas Association Annual Convention — New Orleans.

May

9-10..AGA Gas Supply, Transmission and Storage Conference —Mark-Hopkins Hotel, San Francisco.

20-22..AGA Chemical, Engineering and Manufactured Gas Production Conference — Balmoral Hotel, Miami Beach, Fla.

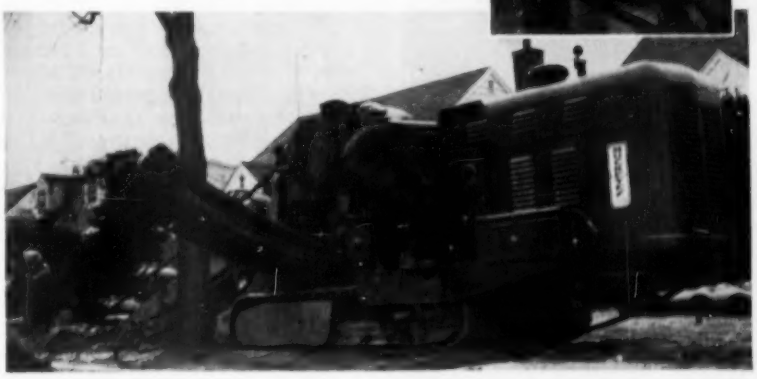
June

23-27..Canadian Gas Association—Jasper Park Lodge, Jasper, Alberta, Canada.

24-25..Michigan Gas Association—Grand Hotel, Mackinac Island, Mich.

Push-Button Conveyor Shift Speeds Ditching with the 407

To clear obstructions, just push a button... conveyor shifts while you keep digging!



Instant conveyor shifting by push-button control is a big Gar Wood-Buckeye Model 407 advantage for utility work. It means faster, easier nonstop work in close quarters and around obstructions. Only Gar Wood-Buckeye has it!

And, only Gar Wood-Buckeye gives you these other important operating advantages: Speeds you can find and use . . . one selector lever plus high-low range lever makes changing speeds easy. Independent lever steering that is positive and reliable. Instant control of live hydraulic boom with positive down-pressure.

In every way, the 407 is far easier to operate, control and adjust than any other ditcher in its class. No wonder it has become the standard for utility work, as well as the world's largest selling ladder-type ditcher! See your Gar Wood-Buckeye dealer, or write direct to: Customer Service Department, Gar Wood Industries, Inc., Wayne, Michigan.

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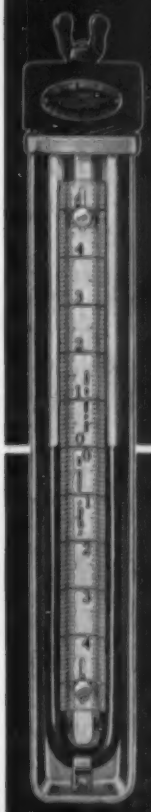
AT LOWEST COST . . . this Meriam Manometer offers high accuracy. The Meriam B-1103 is the easy-to-use, always dependable, form of pressure or flow instrumentation. Pressures to small fractions of an ounce are read directly, accurately . . . without calibration or instrument adjustment . . . with complete enduring manometer reliability.



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associations

Continued from page 84

ber—N. E. Westphal, Weil-McLain Company, Michigan City, Ind.

Gas water heater division; chairman—Frank Osborne, Mission Appliance Corp., Los Angeles; vice chairman—David Cannon, Lawson Manufacturing Co., New Kensington, Pa.; executive committee member—Harry B. Carbon, Bastian Morley Co. Inc., LaPorte, Ind.

Gas vent & flue pipe group; chairman—C. E. Blome, Metalbestos Div., William Wallace Co., Dallas; chairman—B. A. Johnson, Condensation Engineering Corp., Chicago; executive committee member — Packer Brown, Van Packer Corp., Bettendorf, Ia.

Gas furnace division; chairman—Edwin A. Jones, Century Engineering Corp., Cedar Rapids, Iowa; vice chairman — Keith Davis, Carrier Corp., Syracuse, N. Y.; executive committee member—Frank Meyer, Meyer Furnace Co., Peoria.

Metal melting usage urged at industrial conference

According to latest figures available, in 1953 foundries produced 1,012,787 tons of salable castings for which they spent $3,595,000 for gas and nearly $6 million for other fuels. Gasmen attending the recent sales conference on industrial and commercial gas at Roanoke, Va., were told that there is still still a broad field for the gas industry to enter nonferrous metal melting.

Oliver Pritchard, Brooklyn Union Gas Co., told the 200 attendants that "the acceptance of gas fuel is increasing yearly. This trend is given further impetus by the extension of natural gas to many new areas where there is much nonferrous metal melting." There will be new furnace design, he stated, and it is up to the gas industry and equipment manufacturers to see that more and more nonferrous metal melting goes to gas.

For the first time at a section conference, a pipeline executive was a speaker. R. S. Bruns Jr., vice president of Transcontinental Gas Pipe Line Corp., pointed out the importance of a good load factor to a pipeline and how the valuable industrial and commercial load of a distributing company contributed much to a pipeline's stability.

"I believe that industrial sales today are a far more important element than merely a percentage of total sales, but are a means of load balancing which results in the ability to purchase pipeline gas at a uniform high load factor . . ."

L. J. Fretwell, Oklahoma Natural Gas Co., presented a series of slides showing new commercial equipment which

FAST, LOW-COST WAY TO INSTALL PIPE . . .

push it under streets, roads, tracks, lawns with a timesaving

GREENLEE HYDRAULIC PUSHER

Speed underground piping jobs this way. GREENLEE Pusher is one-man-operated (by hand or with power pump), portable, simple to set up and use. No tearing up of pavement, floors, lawns . . . does away with extensive ditching, tunneling, backfilling, repaving. GREENLEE Pusher cuts job time to a fraction . . . often pays for itself on first job.

Two feet per minute average pushing time

GREENLEE Pushers are available in two sizes: No. 790 for ¾" to 4" pipe . . . No. 795 for pipe over 4", concrete sewer pipe, large ducts. Average performance of No. 790, shown above with power pump, two feet per minute. Write for literature.

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Concluding Industrial Gas Day, Oliver Pritchard (left), Brooklyn Union Gas Co., spoke on nonferrous metal melting and K. N. Hawk, East Ohio Gas Co., Cleveland, made a reappraisal of broiler conversions.

has larger inputs than any previously made equipment. This new equipment, he said, can now out-perform any competitive appliances. He urged commercial gasmen to try their best to have their customers upgrade their establishments by installing new and better equipment in order to keep down costs and do a better job in the volume feeding business.

Appalachian measurement course in planning stages

Initial plans have been completed for the 16th annual Appalachian gas measurement short course, scheduled for Aug. 27-29 at West Virginia University, Morgantown.

Attendance by measurement and control engineers and other technical personnel representing the gas and petrochemical industries is expected to be the greatest in the 16 years of this school, according to Earl A. Mowrey, instrument division representative of Rockwell Manufacturing Co. and 1956 short course publicity chairman.

Subjects to be covered in the intensive three-day course will include the fundamentals of gas measurement and special sessions on domestic meters, orifice meters, large capacity meters, automatic control instruments, pressure regulators and other related equipment. Moderated forums will be offered daily on specific phases of measurement and control.

Howard S. Bean, National Bureau of Standards, Washington, D. C., is general chairman and H. B. McNichols, Columbia Gas System Service Corp., Columbus, Ohio, is program chairman. R. E. Hanna and R. W. Laird of the university faculty are in charge of publications, registrations, exhibits and dormitory housing.

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for fast, clean pipe or conduit cutting . . .

7 models for 1/8" to 6" pipe and conduit

efficiency-balanced RIDGID Heavy-Duty Pipe Cutter

It's a tool that knows its business, that comes to your hands like an old friend. It rolls easily through any pipe or conduit, scarcely a trace of burr. Strongly built, guaranteed not to warp or break, always tracks perfectly. Thin-blade or heavy-duty cutter wheels (special wheels for stainless or cast iron). For pipe or conduit cutting that's a satisfaction, buy RIDGID's at your Supply House.

RIDGID 4-WHEEL for easy cutting in tight places

RIDGID Work-Saver Pipe Tools

The Ridge Tool Company, Elyria, Ohio, U. S. A.

ENCLOSED CLUTCH CAN'T STICK OR FREEZE *Ever!*

WINCHES

Put an advanced Gar Wood 7000 lb. winch on your utility truck and you'll put an end to clutch trouble. All moving clutch parts are *fully enclosed and running in oil* . . . can't stick, freeze or rust because weather and dirt can't get in!

You'll put an end to the hazard of sudden slippage, too. Gar Wood's self-energizing safety brake and time-tested back-draft clutch give your operator much safer control of the load.

And that's not all! Gar Wood winches feature stress-free, tempered aluminum alloy housings that are lightweight, rust-proof, built for longer life . . . built-in rope clamp for easier attaching and changing of rope, better spooling . . . self-contained ball-bearing mounted worm shaft for smoother operation . . . extra rugged base angles for an extra margin of safety.

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Regulatory Trends
Continued from page 12

of water resources and planning of the development of the basins of navigable rivers, Congress gave us no authority to make a national policy or plan of conservation of natural gas. This inherent power reposes solely within the jurisdictions of the several states where such natural resource is found." • • •

"In connection with the theories on the end-use of natural gas and the conservation of natural gas as contained in the majority opinion and the separate concurring opinion, we would like to call attention to a less theoretical but more practical approach to the problem. A large percentage of natural gas being transmitted in interstate commerce is what we commonly refer to as casinghead gas. Casinghead gas is gas produced with crude oil with the production of oil usually considered as the primary operation. The denial of the use of natural gas for industrial purposes such as fuel to produce electricity on the theory that such a use is an inferior use of the fuel would actually mean in many instances that the gas would be wasted. It is necessary that the gas be produced in a constant flow and amount since its production is incident to the production of oil produced at a daily allowable rate as fixed by the state where the gas is produced. If this gas is denied the industrial markets on a theory of inferior use, it would have to be flared in the fields where it is produced. Of course, this would constitute a complete waste. Such flaring is generally prohibited by state conservation laws. Thus, we find that a Commission conservation policy could run into a direct conflict with state conservation authority.

"We are very much opposed to this commission's setting up an over-all standard for the end-use of natural gas. We believe that the question of the end-use of gas as a fuel must be considered and determined upon the facts surrounding each individual transaction. Consideration should be given to gas supply, conflicting demands for gas, and the public interest served by its use. Many uses of natural gas which are actually highly efficient should be maintained on an interruptible basis. Gas used in the manufacture of electricity to meet the summer-time peak demand for electric energy for air-conditioning is a splendid example of an efficient interruptible use of gas . . ." ■

THE story of the reward for a better mousetrap is proverbial. But the fact remains that most mice are still caught by this simple, economical and effective contraption.

Gas purification is a parallel case.

Iron Sponge, preferred for the removal of H_2S seventy-five years ago, is still preferred today. And for these same reasons . . . simplicity, economy and effectiveness.

Iron Sponge operates with high efficiency at high or low pressures, has excellent capacity and activity, gives long service between foulings and is simply and quickly regenerated.

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Washington
Continued from page 15

he left the door open for sale to Tennessee Gas.

Witnesses Ratcliffe and Coates, for McLeod, Young, Weir & Co. (investment dealers in Ontario), and Trans-Canada Pipe Lines Ltd., respectively, said that the ability to finance the Trans-Canada project assumed that the Canadian government would finance the "Ontario bridge" section of the line. Mr. Coates summed it as follows—" . . . in substance that the Government of Canada will recommend to Parliament that a Crown Corporation of the Government of Canada be established to construct the section of the proposed Trans-Canada pipeline from the Ontario-Manitoba border to the vicinity of Kapuskasing, Ontario, in conjunction with the remainder of the Trans-Canada's pipeline system. This section will be leased to Trans-Canada for a period of 25 years with Trans-Canada agreeing and having the right to purchase such section at any time during the term of the lease. As recited in the agreement, this section covers a distance of approximately 675 miles and will consist of 30-in. diameter pipe initially equipped with capacity to transmit approximately 300 MMcf/day and designed to have such capacity increased to 530 MMcf/day by installing additional compression facilities."

Mr. Coates, in answer to questions from Counsel Powell, for Northern Natural Gas Co., stated that Trans-Canada intends to construct its project as soon as it gets its financing approved, regardless of whether a certificate has been issued by the FPC in the case of Dockets G-9448, et al or not.

Counsel Powell stated that a document entitled "Excerpts from Prospectus of Canadian Delhi Petroleum Ltd.," dated March 23, 1956, indicated that the main section of the Trans-Canada line ". . . is to consist of 34-in. diameter pipe for which orders have been placed by Tennessee Gas Transmission Co. for Trans-Canada totaling $35 million pursuant to an agreement dated Nov. 1, 1955, between TGT and Trans-Canada. The agreement provides for reimbursement by Trans-Canada for the cost of all such pipe purchased plus interest at 4½% per annum." Counsel Welch, for Trans-Canada, said he knew nothing about that matter.

This hearing makes interesting listening in Washington as it goes on and on. ■

Get all these advantages

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- **30 digging feeds from 12 inches up to 25 lineal feet per minute**
- **6 trench widths from 16 to 26 inches; depths to 5¾ feet**
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When your work schedules call for transmission lines between cities, or additional gas distribution and service lines in town, it will pay you to see what this Parsons 150 wheel-type Trenchliner can do for you. It meets a wide range of trench requirements — combines high-speed operation with exceptional grading accuracy.

Specified grades are easy to maintain. A hydraulic ram on vertical mast raises and lowers the digging wheel — gives fractional-inch depth adjustment, maintains close grade tolerance in toughest digging. Simple mast design eliminates unnecessary superstructure — gives low overhead clearance for work and travel. A separate hydraulic ram tilts the mast, balances weight of the wheel forward for traveling or trailer-loading.

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Corrosion Prevention

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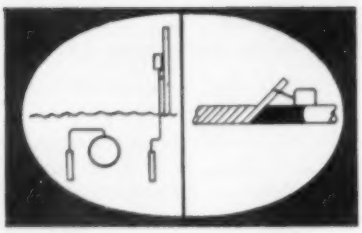

By GUY CORFIELD

Corrosion in gas operations

IN the gas industry there are three broad areas or phases of operation, or types of equipment, which can be considered as susceptible to corrosion. These are the underground piping and other structures buried or in contact with earth; the plants, including compressor stations, steam or other power generating stations, gas manufacturing or treating facilities; and gas-burning appliances, including their venting systems.

External deterioration of buried pipe and other structures in contact with the earth is by far the most serious corrosion problem of the gas industry, the one to which most attention is given, and the one on which most money is spent. The literature is already voluminous and articles will no doubt appear frequently, so no further mention will be made at this time. Internal corrosion of underground gas lines has in the past been a serious problem in some instances. However, with current practices of dehydration, desulfurization and generally cleaner gas, difficulties are largely confined to coping with the residue that was formed by corrosion in former years.

Plant corrosion problems are many and varied, and also both external and internal. The external corrosion, largely resulting from atmospheric attack, can at least for the most part be seen and kept under control by painting or other surface treatment; or, in the case of cooling towers or waterseal holders, by water treatment. Internal corrosion can result from several causes including active chemical types of attack (such as in some dehydrating and desulfurizing processes), which in turn require chemical control methods or use of special metals; and cooling or other process water attack in such equipment as engine jackets and heat transfer units, which can be controlled at least to some degree by water treatment. In dust scrubbers or separators, or other equipment handling gas with entrained solid matter, there is also the problem of abrasion which eats away the metal to produce the same result as corrosion, and usually assists it.

Obviously in a plant where high pressure equipment is operated, or where unscheduled interruptions to service would be costly, or where leakage would be dangerous, a corrosion observation and control program is desirable. Such a program, when internal corrosion is involved, goes well beyond mere non-technical observation. Various expedients are employed by the corrosion engineer to keep the equipment under observation. Analyses of water streams for acidity and oxygen can show their potential corrosiveness, and rust or soluble iron content can indicate that actual deterioration is occurring. "Drips" can be withdrawn, measured and analyzed. Where corrosive influences are known to exist, such as in sulfur removal or dehydration by liquid processes, considerable laboratory and plant experimentation may be necessary to arrive at the best methods of control. A check of metal thickness at critical points can also be very informative. This can be done by a variety of non-destructive methods, i.e., without shutting down the equipment or cutting or in any way damaging the metal. Corrosion "coupons" can be inserted and withdrawn through fittings and packing glands. Special devices are available for insertion in pipelines and vessels, which will exhibit controlled leakage when an internal metal element of known thickness, exposed to the gas or liquid, has corroded through. There are also ultrasonic, radioactive and industrial X-ray types of apparatus which, applied to the outside surface of the metal, will indicate the wall thickness of the line.

Gas-burning appliances and their flues and vents are subject to corrosion from four general causes: the metal in the area of combustion and highest heat transfer is at high temperature in contact with hot combustion products (and sometimes flame) with excess air; the heat transfer surfaces farthest from the combustion area, and the flue and vent, are in contact with warm combustion products and excess air and, during start-up or adverse venting conditions, there may be condensation to produce acidic moisture; in the case of water heaters the tank carries hot water of varying temperature and often high oxygen content; and pilot tubing and orifices, usually operating at elevated temperatures, are exposed to oxygen in the combustion air and sulfur in the gas.

These phases of corrosion have not been neglected, and an extensive amount of information has been accumulated through AGA research and is available in bulletins that can be obtained from AGA headquarters.

This work has provided a general understanding of the factors influencing corrosion in gas appliances, and permitted a choice of material and design that has resulted in many improvements. The study of corrosion of metals and materials at high temperatures, and by flue gas condensate, has disclosed metals, alloys and coatings which can be used instead of ordinary sheet iron to fabricate combustion chambers and heat exchange surfaces which can be operated at higher temperatures and efficiencies, and be smaller in size than was previously possible. The water heater research has indicated factors of design and heat application that have improved the operation and life of galvanized tanks. The work on pilot burners has also shown what factors were responsible for corrosion, and which materials will give greater resistance. ■

GAS people

Promotions

LAMONT J. BRUNDIGE, formerly Sacramento (Calif.) division manager of Pacific Gas & Electric Co., has been promoted to the San Jose division managership. RICHARD L. HAYDEN, manager of customer and community services in San Francisco, succeeds him in the Sacramento post.

DR. OTTO E. ZWANZIG has joined British Columbia Electric Co., Vancouver, as general manager, following the retirement of HOWARD N. WALTERS. Dr. Zwanzig was director of the PAR program of the American Gas Association.

JAMES A. MILLEN, a vice president of Southern Counties Gas Co., Los Angeles, has been elected to the board of directors. Mr. Millen heads the transmission and supply system of the company.

C. B. GAMBLE JR. has become vice president in charge of operations for Laclede Gas Co., St. Louis. He will be relieved of his duties as vice president-engineering, but will have general supervision of engineering matters.

Iowa-Illinois Gas & Electric Co., Davenport, Iowa, has elected ED LERCH vice president and consulting engineer and C. J. MATH vice president, districts and sales. Mr. Math, a former assistant vice president, succeeds Mr. Lerch. R. HOVEY TINSMAN, vice president and treasurer, has been elected a director, succeeding the late C. P. Conrad.

URBAN NIBLO, retired brigadier general, has been named director of government operations of Dresser Industries Inc. and will head up the new Washington, D. C., office.

WILLIAM L. PARCELL has been elected vice president of the Ridge Tool Co., Elyria, Ohio. Mr. Parcell, who celebrates his 20th anniversary with the company this month, served as sales manager prior to his recent promotion and continues as director of sales.

JUSTIN R. WHITING retired last month as chairman of the board of directors of Consumers Power Co., Jackson, Mich. He will continue as a director and has been elected chairman of the finance and budget control committee and the committee on ex-

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people • *Continued*

ecutive organization. JAMES H. CAMPBELL, vice president, was named senior vice president.

JOHN H. WOLFE, who will retire on Oct. 1, has been relieved of his responsibilities as vice president in charge of the gas division of Baltimore (Md.) Gas & Electric Co. He will continue as a consultant until the time of his retirement.

HENRY H. PLANK is the new president and general manager of the Delaware Power & Light Co., Wilmington, succeeding STUART COOPER, who has been president since 1943. Mr. Cooper will continue to serve as chairman of the board and of the executive committee. Also appointed were R. B. RICHARDSON and F. T. BEAR, assistant vice presidents; H. J. PERKNER, assistant comptroller, and H. M. BARRETT, purchasing agent.

ROBERT I. COLEMAN, who has been manager of the Greenwich (Conn.) district of Connecticut Light & Power Co., has been named assistant to Robert P. Stacy, administrative vice president. DONALD S. VALDEN succeeds Mr. Coleman.

The board of directors of the Gas Service Co., Kansas City, Mo., elected BEN C. ADAMS SR. as chairman of the board and R. M. POWER as president of the company at its recent meeting. Mr. Adams, who has been president, will remain the principal executive officer of the company. Mr. Power was executive vice president. Elected to a vice presidency was JERRY T. DUGGAN, general counsel.

B. C. Adams Sr.
Gas Service

D. K. Yorath
Northwestern

D. K. YORATH, who has been general manager of Northwestern Utilities Ltd., Edmonton, Alberta, since 1949, has been named president of that company as well as its Calgary associate, Canadian Western Natural Gas Ltd. R. C. MCPHERSON, general manager of Canadian Western, is now senior vice

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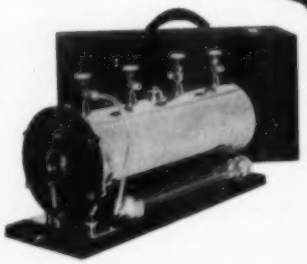

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This instrument has been designed for accuracy in determining specific gravity of gas—it contains no rotating parts that will wear out and operates on the principle of weighing a volume of gas in comparison with an equal volume of air.

president of both companies and will remain as general manager of the Calgary company. Other appointments include that of F. A. SMITH, vice president-finance for both companies; and H. W. FRANCIS, purchasing agent, and B. F. WILSON, assistant general manager, have been elected directors.

New faces

HOWARD WORTHINGTON has joined the Charles Machine Works, Perry, Okla., as sales manager. Mr. Worthington has been manager of the water pump division of Reda Pump Co., Bartlesville, Okla. since 1950.

R. T. Atkinson
Standard

H. Worthington
Charles Machine

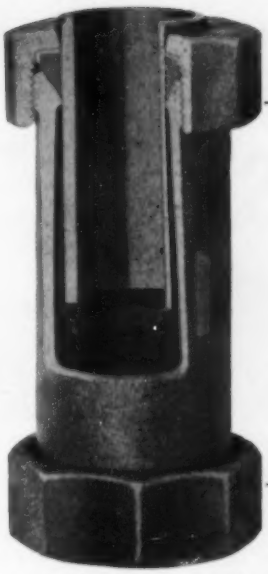
ROBERT T. ATKINS has joined Standard Magnesium Corp., Tulsa, as sales representative for the Chicago area.

Deaths

WILLIAM J. RASCH, retired president of Security Manufacturing Co., Kansa City, died recently in Fort Lauderdale, Fla. Mr. Rasch, who also served as president of American Gas Products Co., a division of American Radiator, was the first president of the Gas Appliance Manufacturers Association.

W. J. Rasch

DOUGLAS WOOD BINNS, 73, president and chairman of the board of Phillips & Buttorff Manufacturing Co., Nashville, died at his home recently after an illness of several weeks. Mr. Binns, who served as head of Phillips & Buttorff since 1927, joined the company in 1918 as sales manager. The following year he became a vice president.



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NORMAC COUPLINGS are made with 5" centers in all sizes. NORMAC SLEEVES are identical in design except that they are made with 10" centers. Nuts and gaskets are interchangeable.

Compression-End Service "Tee"—First fitting of this type ever produced with full coupling depth and special threads on male end to prevent dropping into old hand taps when used to replace standard threaded fittings.

Compression-End Service "Ell" — Extra depth makes it possible to "stab" pipe into stops and without measuring, pull back a safe distance to allow ultimate deflection eliminating possibility of strain against tap in main.

Compression-End Iron Body Brass Core Service Stopcocks—End the necessity of threading on the job plus the elimination of the threads themselves—combining all the advantages of NORMAC COUPLINGS and the best in stopcock design. 2½" coupling depth on each end.

Normac Brass Fittings Developed in 1939 for Use with Copper Tubing—Our complete line of brass fittings can be used either on new installations or where copper is run through old steel pipe in large or small openings. The center to end dimensions of NORMAC TEES correspond with old malleable iron fittings. This feature is extremely important in the use of these fittings in one foot openings where the tubing must line up with the steel which has been removed.

Write for the NORMAC CATALOG of Gas Distribution Equipment

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Gas Digest

A digest of what's new in products and trade literature compiled by the editors of GAS as a reader service.

New Products and Trade Literature

For more data on any of these items use the Readers' Service Card on pages 99, 100

1. Beveling machine

H & M Pipe Beveling Machine Co. has introduced a portable flame cutting and beveling machine for small-diameter pipe 1½ to 4 in. The new unit is expected to have wide application in many industries, especially where the fabrication and use of small-diameter pipe is an important factor.

The completely portable Model O, weighing 7½ lb, employs the same split gear horseshoe principle as the company's larger units, which allows the operator to place the machine on continuous pieces of pipe. A quick-operating, specially designed boomer strap speeds up the process of changing the machine from one piece of pipe to another.

H & M Pipe Beveling Machine Co.

■

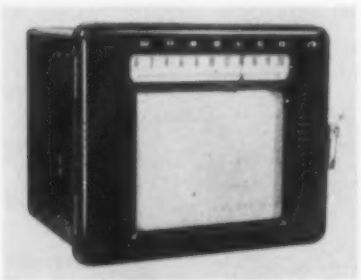
2. Portable compressors

Ingersoll-Rand's Gyro-Flo line of rotary portable compressors has been increased to five sizes—125-900 rpm—with the addition of a new 900-cfm size.

The new compressor weighs 14,340 lb. Delivering full 900 cfm at 100 psi, the Gyro-Flo has capacity to operate 10 jackhammer or 7 wagonjacks with light drifters, or three wagon drills with heavy drifters.

Ingersoll-Rand

■



3. Potentiometer

An electronic potentiometer-recorder (Series 8000) of the null-balancing type has been developed by Wheelco Instruments division of Barber-Colman.

The completely self-contained unit requires only an external sensing device. The recorder has been designed to provide maximum accuracy, simple operation, and minimum maintenance.

Most important applications for the new instrument will be for measurement and control of temperatures in the pyrometric range; as a resistance thermometer-type of system; to measure speed; as a radiation receiver (pyrometer); and for any function that can be resolved to a d-c signal load and the measurement of pressures through use of a strain gauge (primary element).

Barber-Colman Co.

4. Gas leak probe

Prospecting for gas leaks is reportedly twice as easy with Engineers Tool Co.'s new gas leak probe. The M-pact-O probe is to be used with explosion test meters. Its impaction feature is said to eliminate hammering with a heavy sledge, saving bruised knuckles and broken hands. Reciprocating motion of weighted handle operates it.

Probe will penetrate to depth of 40 in. Spark resistant probes and probes for deeper penetration are also available. M-Pact-O will penetrate 6 in. of asphalt.

Engineers Tool Co.

■

5. Desk-top base station

Finger-tip control without the use of control lines is featured in a new desk-top model base station recently

added to the two-way radio communications line of Allen B. DuMont Laboratories.

Model MCA-155-B is a complete base station for desk-top mounting and is designed to meet requirements of dispatchers and others to provide the complete facilities of a base station with the convenience and reliability of a desk telephone. A front-panel meter checks complete performance.

The unit's full line of accessories includes digital clock, dual frequency transmitter and/or receiver, and foot switch. The frequency range is a 25-54 mc, 40 watts minimum output.

Allen B. DuMont Laboratories

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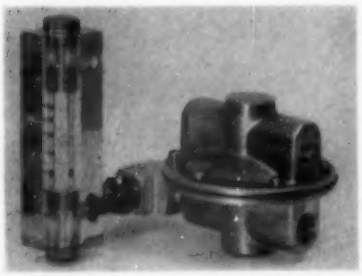

6. Pressure regulator

Recently developed by Conoflow Corp. is a new differential pressure regulator incorporating a self-contained needle valve.

Designated Model H-21F, the differential relay can be used for economical purging with air, water, or gas in services where actual measurement of the flow is unnecessary. It can also be supplied in combination with a small flow rate indicator as a complete, compact purge meter package. Ranges from 0.2 to 2.0 scfh of air and 20 to 200 cc/minute of water are available.

Conoflow Corp.

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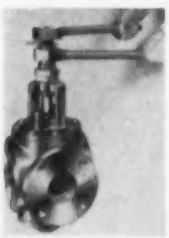
7. Plug valve



Republic Manufacturing Co.'s new plug valve is designed to handle abrasive solids in suspension, as well as oil, gases, and chemicals. Seating force on the plug is applied manually. Turning torque is very low since the plug is only turned after being raised from its seat.

The plug is coated with synthetic rubber. The valve is actuated by two wrenches: a quarter turn of the lower wrench raises the plug from its seat, providing clearance which eliminates friction and wear between seat and plug. While raised, it is turned with the upper wrench for the desired flow pattern.

Republic Manufacturing Co.

■

8. Noise analyzer

The "Soundscope" is a new electronic instrument introduced by Mine Safety Appliances Co. to aid in the fight against industrial noise.

Combined in the portable, 20-lb unit are four principal functions necessary to measure and analyze noise accurately. The instrument serves as a meter to measure overall sound levels. It operates as an analyzer, measuring sound in each of eight octave bands to determine noise peaks, and it can check sound in narrower frequency bands. Electrical and acoustical calibrators are built into the unit.

Mine Safety Appliances Co.

■

9. Excavator

Ease of operation and reduced maintenance costs are features claimed by a new Koehring excavator in the ¾-cu yd class. Designated as Model 305, the new excavator has a rated lift crane capacity of 25 tons on truck chassis, 15 tons on crawler mounting. It can be equipped with a full complement of attachments.

Safety and wear-resisting features of larger Koehring excavators are embodied in the 305, including self-cleaning crawlers, automatic traction brakes, a newly designed cab and operating lever arrangement, and a mechanical cam-type booster clutch on the main drum clutches.

Koehring Co.

■

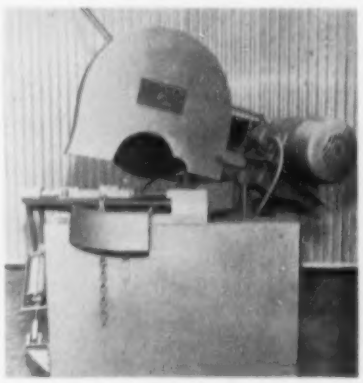
10. Expansion union

Crouse - Hinds new one-piece sliding sleeve expansion union is said to compensate for conduit which has been cut too short. At the same time it eliminates the need for springing conduit to one side while installation of the union is made.

These condulets, made in standard and extra long lengths, are small in diameter and are available in ½-, ¾-, and 1-in. sizes. They are readily used in installations where unions of larger diameter would make connection difficult.

Crouse-Hinds Co.

■



11. Cutting machines

Beaver Pipe Tools' Abrasive Machine division has added two abrasive cutting machines to its line.

The No. 20 cutting machine uses the No. 20 standard cutting head mounted on a special base with the pivot built in the base. Vise and material remain stationary. Cutting head swivels in a 60° arc, permitting any angle cut from 30 to 90°.

The Beaver No. 20 wet-cutting abrasive cutting machine (pictured) is equipped with magnetic switch and air vise. The cutting wheel is completely shielded. This, combined with the apron around the machine, prevents splashing.

Beaver Pipe Tools Inc.

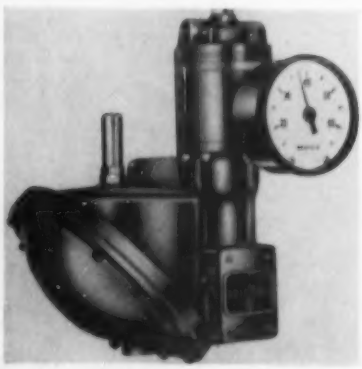
12. Forced air furnace

Kresky Manufacturing Co.'s new counterflow gas-fired central heating forced air furnace ranges in size from 75,000 to 150,000 Btu input.

Features include oversize blowers which enable the unit to be easily applied to air conditioning. Filters can be replaced without removing the flue pipe or draft diverter. The furnace has an extra heavy heating element which is die-formed and electrically welded.

Kresky Manufacturing Co. Inc.

■



13. Pressure transmitter

Bristol is producing a new absolute pressure transmitter.

The metagraphic absolute pressure transmitter is available to handle pressure ranges from 0-5 mm Hg to 0-760 mm Hg. It transmits a universal 3-15 psi pneumatic signal and can be used with any standard pneumatic receiver or automatic controller.

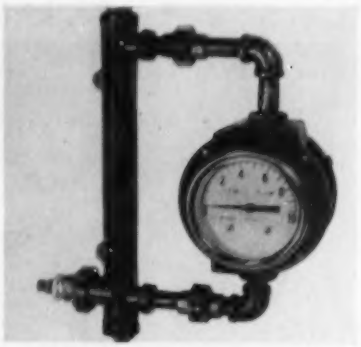
Bristol Co.

■

14. Vane-type flow meter

Scully-Jones instrument division's vane-type flow meter for air or gas flow has been designed for a constant pressure drop across the meter and may be used for indicating, controlling, signal alarm, safety shutoff, sequence starting or shutdown, and similar applications.

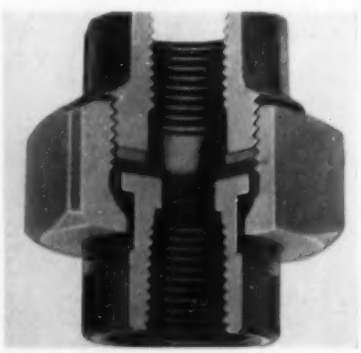
In operation, as the vane rotates with increase in flow, the area between the end of the vane and the flexible spline in the meter body increases. This increase approximates the law of squares to provide pointer stability and an easy-



to-read scale. By varying the weight of the vane and the area, various capacities can be produced. Pointer movement on the dial is multiplied by gearing to produce a dial that is easily read at a distance.

Scully-Jones & Co.

■



15. Insulating unions

A new line of insulating unions from Eclipse Fuel has been designed to stop electrolytic corrosion of mains and services.

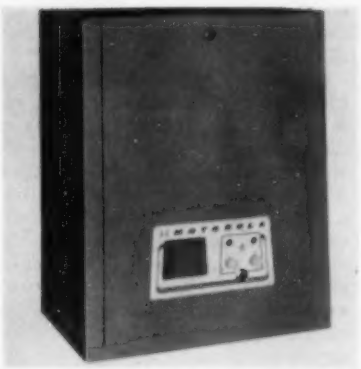
Jumping and shorting of induced or stray house currents across the union is eliminated by the Wedgeseal insulator, which extends over the flange and washer face. The new insulator is an integral part of the tailpiece and requires on assembly. Mating tapers in the insulator produce a wedging action for a tight fit without shearing action between the tailpiece and the nut.

Eclipse Fuel Engineering Co.

■

16. Transmitter-receiver

The Compa-Station transmitter-receiver has been added to Motorola's standard line of fixed FM two-way



radio equipment operating in the 25-54 or 144-174 megacycle band. Included in the unit are a 60-watt transmitter and the Sensicon "G" receiver.

Removable control panel has a built-in speaker which can be placed in several positions on the cabinet for versatility in installation. The control panel itself can be removed and placed in any desired location for extended local control operation.

Proper ventilation for base station operation is provided by the 22 x 13½ x 29 in. cabinet which is finished in deep gray baked-on enamel and has full length front and rear key-locked doors. The unit operates from any standard 117-v, 60-cycle source.

Motorola Inc.

■

17. Air conditioner

Servel's new 3-ton all-year gas air conditioner provides both heating and cooling through a single heat exchanger. The compact single-coil, direct-fired unit occupies only 10.4 sq ft. It is ready for utility connections, ducts, and vents the moment it is uncrated and placed.

Carrying the model designation FCA-96G, the Sun Valley unit has a 96,000-Btu/hr output heating capacity. It delivers a maximum of 1600 cu ft per minute on the cooling cycle with the built-in bypass open.

Servel Inc.

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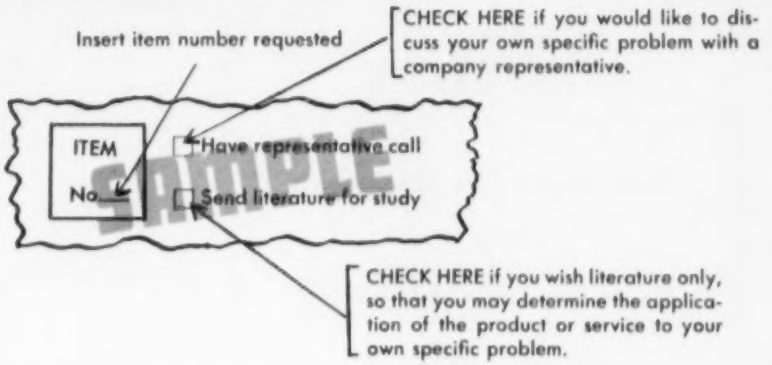
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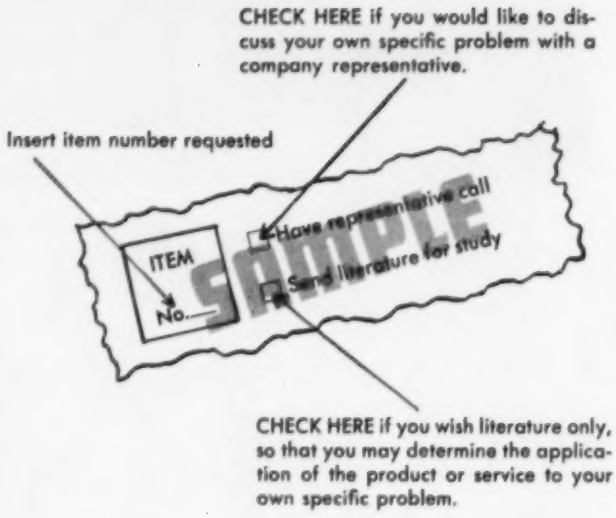
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18. Backhoe attachment

Wain-Roy Corp's new combination back-hoe blade attachment for the International 300 tractor has been engineered to handle a number of trenching jobs, bell hole and foundation excavation, plus backfilling, leveling, grading, etc.

The hoe is a complete, self-contained unit and can be removed or attached in less than 30 minutes. The effective digging depth of the hoe is 11 ft and, because it is able to dig and dump in a 190° radius, the hoe may be worked in extremely cramped quarters, reducing interference from passing traffic.

Wain-Roy Corp.

■

19. Built-in range

Gaffers & Sattler has introduced its first built-in oven and burners.

One of the outstanding features of the built-in range is the Oven Sentinel automatic roasting control. The dial of the control can be set to rare, medium, well-done, or any point in between. The stainless steel probe is inserted in the meat, and the oven is turned on. When the roast is done, the oven automatically shuts off, and a signal indicates the meat or poultry is ready for serving.

Gaffers & Sattler

TRADE LITERATURE

20. Transfer switch brochure

"Factors to Consider in the Selection of Automatic Transfer Switches" is the title of a new 16-page brochure from Automatic Switch Co. Ten factors required for adequate design are concisely listed and illustrated, and then information on why these features are essential is presented.

Automatic Switch Co.

■

21. Corrosion report

Results of economic studies on the use of magnesium anodes for arresting corrosion of buried or submerged metallic structures are presented in a report from Corrosion Services Inc. Titled "What Size Anode Should You Use," the report presents a comparision of various sizes and shapes of anodes to use in soils of various resistivities.

Corrosion Services Inc.

■

22. Compressor catalog

Cooper-Bessemer's newest compressor, Type FMP, is described in a new engineering catalog. The Type FMP reciprocating compressor is built for field pick-up service, gas boosting, air drilling, and general industrial use. It is available with either single or twin frames, with single or multi-stage compressor cylinders.

Cooper-Bessemer Corp.

■

23. Burner bulletin

Selas ribbon burners, specially designed gas-fired heating units which produce a narrow, uniform sheet or ribbon of flame, are described in Selas Corp's new Bulletin SC-1004. Presented are heating techniques, selection data, and a capacity chart for the ribbon burners, which are usually employed in continuous heat processing applications.

Selas Corp. of America

■

24. Trencher folder

A portable, one-man-operated machine to dig trenches for pipe or tubing is the subject of a folder from Stampings Inc. The Pow-R-Spade, which digs a 2½-in. wide trench to any depth up to 24 in., is described by pictures and text.

Stampings Inc.

25. Fitting folder

Tube Turns wrought iron welding fittings and flanges are described in a new folder which gives dimensional data on Tube Turns products in sizes from ½ in. through 12 in., discusses the physical properties of the material, and illustrates typical applications.

Tube Turns

■

26. Chart pen brochure

Features of chart pen design and operation are explained and illustrated in a new multi-color brochure from American Recording Chart Co. The new Arcco bulletin (110-R1) uses diagrams and sketches to point out to the beginner and experienced fieldman the features of Arcco chart pens for permanent recording on instrument charts.

American Recording Chart Co.

■

27. Motor bulletin

Construction features of Allis-Chalmers weather-protected motors for outdoor installation are presented in a new bulletin (05B7874B). Mechanical features of the motors are portrayed in the bulletin by means of a cross section diagram of a typical 700-hp, 2300-v, 1185-rpm squirrel-cage induction machine.

Allis-Chalmers Manufacturing Co.

■

28. Heat exchange catalog

Air-cooled heat exchangers from Griscom-Russell are described in 24-page bulletin just published. Bulletin 2400 covers design details, construction, distinctive features and applications of the G-R fin-fan exchanger. Also included are specifications, sketches of available arrangements and descriptions of mechanical equipment and control apparatus for various service requirements.

Griscom-Russell Co.

■

29. Instrument book

In a new 40-page reference book just published by General Electric's instrument department, eighty different testing instruments are covered. The measurement equipment catalog (GEC-1016) contains complete product information including applications, sources of additional information and pictures.

General Electric Co.

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Hydrauger bored holes for pipe installation invariably reduce costs 80% to 90% by eliminating trenching and back-filling to say nothing of man-hour labor savings and safety to highway traffic.

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"The Most Satisfactory Ditching Machine We've Ever Operated"

Say Jay Cundiff and Mac McVain
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"We recently purchased our third Vermeer Model 4T Pow-R-Ditcher. This "Midget ditcher" is ideal for digging in those "tight spots." It is the most compact and satisfactory ditcher for gas service connections that we have found."

"Easy to transport," says Mac McVain.

VERMEER 4T POW-R-DITCHER DIGS FOR LESS BECAUSE IT COSTS SO MUCH LESS

The 4T Pow-R-Ditcher is only 44" wide and is easily transported in a pickup truck. Digs 6" to 14" wide and 4½' deep. Ideal for laying gas pipe, service lines and digging foundation footings. Only 6' high, 13' long, the 4T is self-propelled and one-man operated. Same size moving parts as larger models. Write for name of distributor and full information on the complete Pow-R-Ditcher line.

Some Excellent Sales Territory Available

VERMEER MFG. CO.
Pella, Iowa

"Well built machine and a fast digger," says Jay Cundiff.

GAS news

Northern Ontario to have $11 million gas system

An $11 million natural gas distribution system to serve 20 northern Ontario communities will soon be given the green light, according to A. R. Crozier, chairman of the Ontario Fuel Board.

With the authorization, Northern Ontario Natural Gas Co. will distribute gas transported by Trans-Canada Pipe Line Ltd. from Alberta to a chain of communities from Hearst to North Bay, including Timmins, Kirkland Lake, Cobalt, New Liskard, and Haileybury.

The company, which plans to complete the distribution system in five years, hopes to extend its services to Sudbury and Barrie.

Utah Gas Service gets franchises for gas service

Two southern Utah counties and 13 communities within those counties granted franchises authorizing construction and operation of a natural gas distribution system to Utah Gas Service Co.

The counties are Sanpete and Sevier. Municipalities include Fairview, Morono, Mt. Pleasant, Spring City, Ephraim, Manti, Sterling, Gunnison, and Centerfield in Sanpete, and Redmond, Aurora, Salina, and Richfield in Sevier.

Portland Gas seeks okay of acquisition

Portland (Ore.) Gas & Coke Co., which contemplates changing its name to Northwest Natural Gas Co., will acquire United Gas Corp., supplier of L. P. gas to Camas and Washougal, Wash., upon approval of Washington and Oregon regulatory authorities.

The acquisition involves an exchange of all of the stock of United Gas for 14,000 shares of Portland Gas stock.

United Gas, which supplies LPG through 30 miles of mains to nearly 800 customers, plans to change over to natural gas late this summer under

a contract with Pacific Northwest Pipeline Corp.

John S. Shute, major owner, president, and manager of United Gas, will continue active with the firm in a consulting capacity. No change in United's operation is contemplated, Charles H. Gueffroy, Portland Gas head, said. The system will be expanded with needs of the area and eventually will be linked to Portland's network in Vancouver, about 12 miles west of the Cama-Washougal area. The smaller company will be combined with the larger, if the deal wins approval.

Stock or cash dividends paid by Citizens Utilities

Citizens Utilities Co., Stamford, Conn., is laying the groundwork in an unprecedented step in corporate finance which will see shareholders take their dividends in either cash or company stock.

The company has been paying cash dividends plus stock disbursements. The response in favor of stock dividends has been almost unbelievable. On the closing date of April 14, for exchange of stock, some 75% of the shareholders had elected to receive their dividends entirely in stock. Company President Richard L. Rosenthal says that "even the most enthusiastic outside proponents . . . felt it would be highly unusual if as much as 30% of our shares were exchanged . . . we felt sure the percentage would be much higher but our most optimistic estimates did not exceed 50%."

Under the plan—first of its type in the annals of investment banking—the company has reclassified all common

Walter Lucking (right), president of Arizona Public Service Co., Phoenix, accepts a certificate of "Management Excellence" from Frederick P. Harrison, vice president of the American Institute of Management. The certificate was awarded the utility by the AIM following a management audit of the company's operations for the year 1955.

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Use Telsco Fittings on Plastic Pipe, too—Metal Stiffeners for this application are available.

The unique sealing principle used in Telsco Threadless Fittings concentrates great pressure, under containment, on *all sides of a small rubber gasket* (See cross section). Under this tremendous pressure, confined in a small area, the gasket forms a tight seal against leaks.

At the factory every Telsco Fitting gets a 90-pound air pressure test, under water—assuring a sound casting every time.

Telsco Fittings do not insulate. Instead they conduct static electricity without the time, effort and cost of bonding every connection.

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stock into Series A and Series B with holders of Series A getting their dividends in stock and owners of Series B receiving theirs in cash. This optional plan is being closely watched by the utility and other industries. It is believed that it could well mark the inauguration of a brand new trend in financing, particularly for utilities.

It offers the capitalization of retained earnings for a utility operation, imparting a true growth aspect to an equity classification that has long been considered as strictly an income investment.

Mr. Rosenthal feels that the acceptance of the plan "is positive evidence that investors are eager for a financing method which will avoid the inequity of dilution and carry the benefits of long-term capital gains for their investment portfolios."

He added, "It is also evidence that they recognize the substantial savings their corporations can achieve by foregoing the expense of new equity financing. The fact that this method also tends to minimize dilution of shareholders' equities by giving them the opportunity to maintain their proportionate ownership is also an important aspect of the plan."

Heating shipments ahead of 1955's record total

All types of gas-fired central heating equipment went out in substantially greater quantities during the first quarter of this year than in the corresponding period of record-breaking 1955, according to figures just released by Edward R. Martin, director of marketing and statistics of Gas Appliance Manufacturers Association.

The three-months shipments of gas furnaces of the forced warm air and gravity types totaled 168,900, up 11% from the 152,100 in the 1955 quarter. The March total of 60,400 was 12.5% over the corresponding month of last year.

Gas-fired boilers scored a 37.9% gain with a three-month total of 17,100. For March the figure, 6800, was up 36% over the 1955 month.

Conversion burners accounted for 23,100 unit shipments in the quarter and 8400 in March. These totals represented gains of 21.6 and 13.5%, respectively, over the corresponding 1955 figures.

Mr. Martin pointed out that March was the 26th consecutive month in which gas furnaces showed an increase over the previous comparable period.

On the other side of the ledger were shipments of domestic gas ranges, which during the first quarter of 1956

were 6.5% below those in the corresponding 1955 period. First-quarter shipments stand at 521,500 units as against 558,000 in the first three months of last year. The March total was 183,500, 15.9% below the 218,000 recorded last March.

It was pointed out by Mr. Martin that shipment figures do not include built-in units, which are currently gaining rapidly in popularity, particularly in new housing.

B. C. Electric sees rates cut up to 52% for some

If approved by the Public Utilities Commission, natural gas rates filed by British Columbia Electric Co. Ltd., for the Lower Mainland will save residential customers up to 52% of present manufactured gas costs.

Commenting on the proposed firm rates, H. L. Purdy, executive vice president of the Vancouver, B. C., company, said they were lower in each category than those originally estimated at last year's public hearing on natural gas. "Our residential rates are much along the same lines as those announced recently in Portland (Ore.), which, like this area, is getting delivery of natural gas for the first time next fall," he said.

Customers using natural gas for cooking or other small use may save as much as 25%; for cooking and water heating, the reduction is estimated at 23%; for househeating only, users will save from 34 to 44%, compared to the present cost of heating with manufactured gas. Depending on the size and type of house and the appliances used in it, rates for cooking, water heating, and househeating can run from 36 to 52% lower.

Chiefly for commercial customers, the company has filed a general rate which would yield savings of 27 to 30% over existing manufactured gas costs. For large industrial users, the proposed rates will bring savings of around 50% and, said Mr. Purdy, it is expected that natural gas will be able to compete successfully with other fuels for a great variety of boiler, industrial processing and other purposes. The company also proposes to introduce interruptible industrial rates.

Three Colorado companies merge into Plateau Natural

Colorado's Public Utilities Commission has issued an order approving the merger of three Colorado natural gas companies into one firm to be called the Plateau Natural Gas Co. Main offices will be in Colorado Springs.

The company bought the stocks of Kansas-Colorado Utilities Inc., Lamar;

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JOSEPH F. DUDDY, GEN. MGR.

news • *Continued*

the Midwest Natural Gas Co., Florence; and Pikes Peak Natural Gas Co., Limon. Plateau Natural is backed by John D. Murchison and headed by Bruce Fullerton.

Also approved by the PUC was issuance of new securities amounting to about $2.5 million to finance the new company's operations.

Industries signing up fast for natural gas

Major industries in the Puget Sound (Wash.) area have already signed up for 27% of the total amount of interruptible gas allotted to the area under contracts with Pacific Northwest Pipeline Corp., according to Walter S. Byrne, president of Washington Natural Gas Co., Seattle.

New lower rates have been proposed for industrial use on a firm basis, which will mean average system reductions up to 50% in this rate classification. Although gas will not be available until late fall, five-year contracts amounting to more than $5 million and totaling 15.7 MMcf/day have been signed to date. The rate for firm gas is $170 net for the first 2000 therms or less, 8 cents per therm for the next 8000 and 7.5 cents for all additional therms.

Mr. Byrne reports that every basic industry "in our service area is represented among the firms which have signed contracts to use natural gas on an interruptible basis and additional contracts are being signed almost daily."

"Over the state, interruptible gas is going at an equally rapid pace," he added.

Including huge sales to aluminum companies, and direct industrial interruptible sales by the pipeline company, the total amount of gas committed, for five-year and longer periods, is about 100 MMcf for Washington alone.

Washington Natural's industrial rates, coupled with the advantage of a supplementary supply of gas from Canada, are expected to provide a tremendous stimulus to industrial development in western Washington.

Industrial sales contracts already held by Washington Natural for interruptible gas represent annual thermal requirements approximately equivalent to three times the company's total production of manufactured gas in 1955. Industries already signed up are metals, foods, wood and agricultural product processors, chemicals, and ceramics.

Proposed rate reductions for all classes of gas service will mean savings of approximately $1.6 million to Washington Natural's 50,000 present customers from Everett to Centralia-

Chehalis inclusive, Mr. Byrne said. The greatest domestic savings will be made by househeating customers. Uniform rates will apply for all cities regardless of size. Average reductions from current manufactured gas heating prices will vary from 38 to 48%. Average system rate reductions for general domestic service will vary from 17 to 30%, for commercial heating from 16 to 38%, and for general commercial service from 18 to 37%.

Carrier plans $6 million West Coast plant

A $6 million West Coast plant for production of air conditioning equipment, furnaces, and water heaters will get under way this year by Carrier Corp., according to Lyle C. Harvey, senior vice president.

Located 18 miles east of Los Angeles, in Puente, the new manufacturing, engineering and office facility will have an area in excess of ½ million sq ft. The plant will provide expanded facilities for the growing needs of the Day & Night and Payne divisions of Carrier and, in addition, will produce certain types of equipment for other Carrier divisions.

William J. Bailey, Carrier vice president and general manager of the divisions now located at Monrovia, Calif., will be in overall charge of the new plant. Since the Puente site is only 10 miles from Monrovia, it is anticipated that virtually all employees will transfer to the new plant when it is completed in 1957.

Mr. Bailey stated that the present operations of the Monrovia Aviation division will continue at the Monrovia site and the Spectrol Electronic division will remain at nearby San Gabriel.

ConEd aims at $4 million more revenue in '56

Consolidated Edison Co. of New York told appliance and plumbing trade groups in New York City and Westchester county recently that the goal of its 1956 gas heating campaign is to add $4,375,000 annual revenue from new residential, commercial and industrial gas space and water heating installations.

The 1956 gas promotion expands the main feature of last year's campaign which resulted in the sale of 10,675 new gas space and water heating installations representing annual revenue of more than $3 million.

This year's campaign is aimed at about 200,000 single and two-family homes in ConEd territory still heated by other fuels than gas and also at a new potential residential space and wa-

Close Quarters?

Get a Hydrohoe

When close-quarter digging gets you in a corner, you can depend on a Bucyrus-Erie Hydrohoe to get you out — and at a saving in time and money.

This compact all-hydraulic truck-hoe with its extremely short tail swing not only speeds easy-to-get-at digging but also squeezes into narrow passageways, edges close to obstructions and moves dirt out in a hurry. You can trench out for main and house connection lines, dig manholes, uncover pipe leaks—handle these and other jobs in locations where ordinary equipment just can't maneuver properly.

Extra advantages in close-quarter digging are provided by the Hydrohoe's telescoping boom and wrist-action dipper. Merely by extending and retracting the boom, the operator can regulate his digging ranges, permitting him to work in extremely close quarters. By working wrist action along with boom telescope, he can pry out objects obstructing digging . . . can work effectively around cross pipes.

Standard Hydrohoe dipper is 18" wide. Available as extra equipment are a narrow-type dipper, 12" wide, and wide-type dippers up to 60" wide, plus a special 20" utilities dipper designed to dig shorter trenches with greater depth than length. Optional remote control permits driving truck right from the Hydrohoe operating cab. Your Bucyrus-Erie distributor will be happy to arrange a demonstration on your job. 150H56

BUCYRUS-ERIE COMPANY

South Milwaukee, Wisconsin

BUCYRUS ERIE HYDROCRANE BUCYRUS ERIE HYDROHOE

ter heating market comprising about 40,000 smaller apartment buildings.

Private homeowners will be offered selections to meet their needs from a three-part promotional package. This includes a gas conversion burner installation, a gas-designed boiler and an automatic gas water heater, each to be installed with a two-year free service contract and to be available on time payment financing.

One of the first moves in the campaign will feature personal calls by Con Edison sales representatives on a prime lead group of some 1500 homeowners who heat their homes with coal-burning equipment or oil burners more than 10 years old.

A new feature in this year's gas campaign is the effort directed at the residential apartment house and space heating market. The stimulus for development of this market is the fact than under a new apartment house gas heating rate put into effect April 16, the residential portion of an apartment building now can be heated with gas at the same low rates formerly available only to private homes.

The new apartment house heating rate makes gas competitive in price with the types of fuels generally used to heat some 40,000 smaller apartment buildings in Con Edison's gas territory. The company's sales department hopes to sell gas service to at least 4000 such buildings over the next five years.

ConEdison Sales Promotion Manager J. C. Murtha, addressing New York City appliance and plumbing trade groups at the Kingsbridge service training center to announce ConEdison's 1956 gas promotion.

Interior okays Alaskan development contract

Colorado Oil & Gas Corp., Denver, has received a contract from the Interior Department to search for gas and petroleum in southern Alaska.

The contract, which stems from 470 individual lease applications covering 1.2 million acres, calls for Colorado to spend at least $250,000 for exploratory work by April 1, 1957, and at least equal amounts thereafter before April 1, 1959, 1960, and 1961. Drilling is to begin not later than July 1, 1959, on a test well at a site to be approved by the department. The contract will run for 10 years unless terminated by relinquishing or by cancellation for failure to comply.

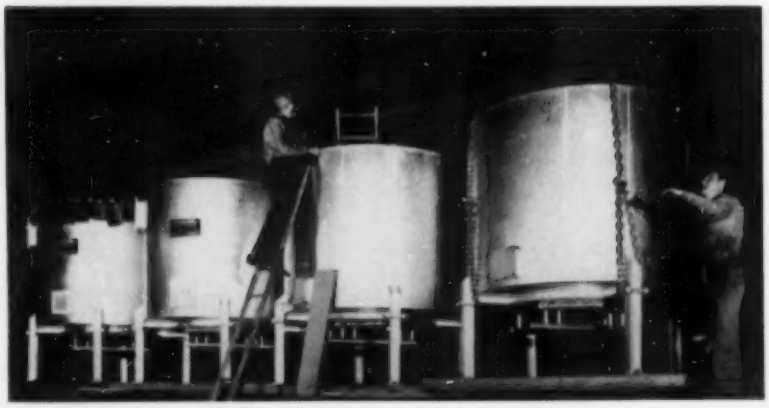
This is the third such contract signed by the department since 1953.

Selas ships furnace for processing uranium ore

The first major shipment from the new Dresher, Pa., plant of Selas Corp. of America was made up of four automatic gas-fired furnace settings for processing uranium ore.

In each of the enclosed Duradiant settings, radiant heat and combustion products are directed at a kettle bottom at short range for extremely fast heating and efficient heat transfer, producing temperature uniformity within a few degrees Fahrenheit. The settings will be operated by control panels, with fully automatic safety, pilot, and precision temperature program controls.

The furnaces have been completely fabricated at the Selas factory, and are shipped complete with combustion system, ready for installation of the stainless steel kettle.



Workers load first major shipment from Selas Corp.'s new plant. The automatic gas-fired furnace settings will be used for processing uranium ore.

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Anchor's Engineering Dept. will design and supervise plant construction.

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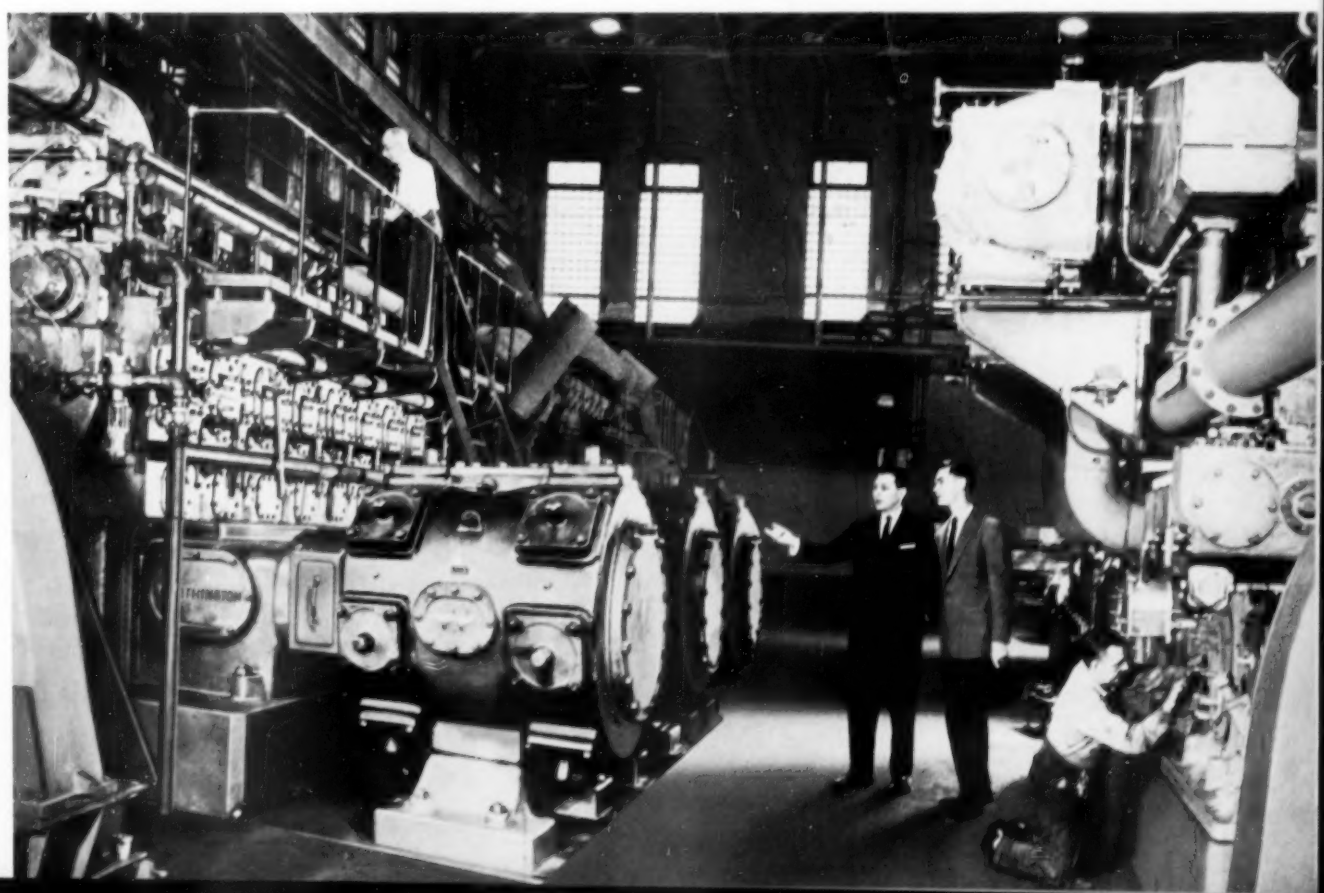
First 2-cycle pipeline compressor with exhaust-powered turbo-charging at all loads . . .

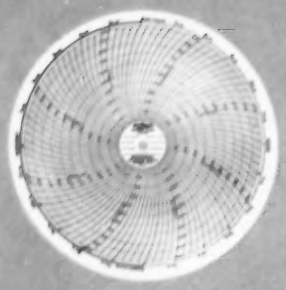
The unique TURBO-UNIFLO has no power draining extra-drive for supercharging from start-up through full load. Individual aftercoolers adjacent each cylinder give maximum load capacity *with* accessibility. Low cycle temperatures reduce maintenance on liners, heads and pistons.

The TURBO-UNIFLO, Worthington's SUTC gas-engine compressor has had remarkable acceptance in its first production year. More than twenty-four are either installed or on order.

Elimination of any mechanically-driven air charging device, and other exclusive design features, make this the quietest 2-cycle engine compressor in the industry. Other *construction* features such as balanced-strain nodular-iron cylinder heads also make this new pipeline unit notable for reliability. For details, write for bulletin S-550-B23D to Section E64.

Worthington Corporation, Harrison, N. J. E64





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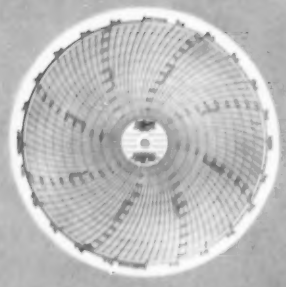

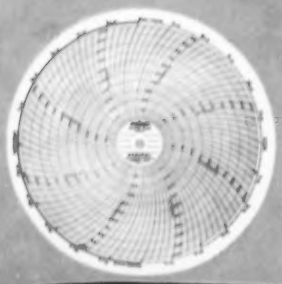

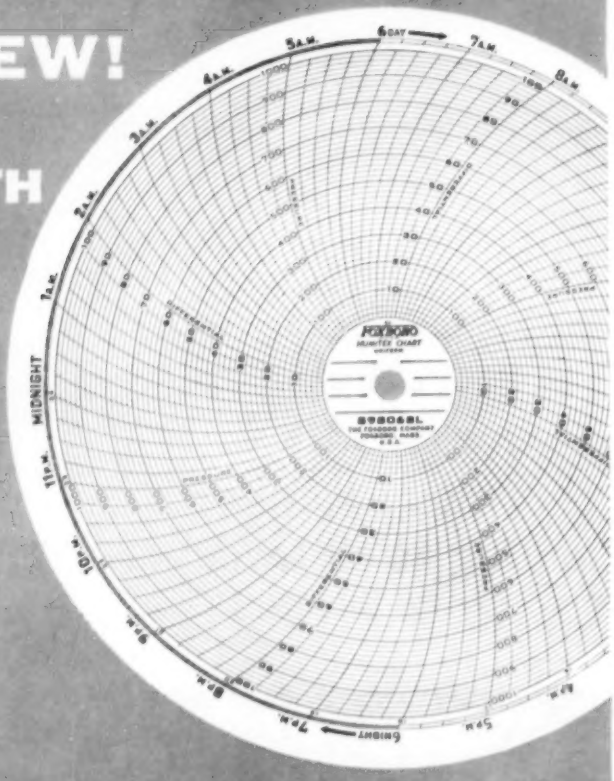

...FOXBORO HUMITEX CHARTS *stabilized* for "cash register" metering

Like standard Foxboro Humitex Charts, these new *stabilized* charts have extra-high legibility too. Easy-to-read gray printing against the chart's smooth, white background brings out the full brilliance of Foxboro Recording Inks.

Here are the charts specifically designed to meet the high-accuracy requirements of "cash register" metering . . . Foxboro *stabilized* Humitex Charts. These advanced charts feature plastic-laminated paper — assure you *real* dimensional stability under the widest variations in temperature and humidity. In an extensive series of laboratory and field tests, Foxboro *stabilized* Humitex Charts were found to have only ¼ to ⅓ as much dimensional error as the highest grade of standard charts!

Foxboro *stabilized* Humitex Charts are your assurance of consistent, high-fidelity records — wherever you meter — wherever you compute. Try them at our expense. Write for samples and quotation. **The Foxboro Company, 346 Norfolk St., Foxboro, Mass., U.S.A.**

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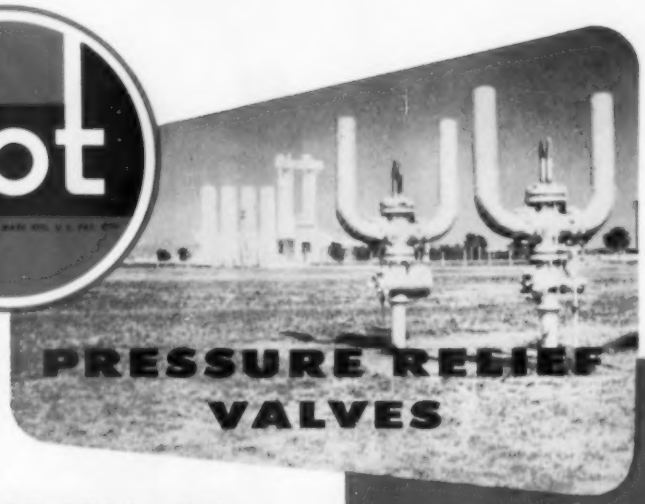

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Bubble-tight closure against gas or liquid is assured by the soft seat design in GOT Pressure Relief Valves. Metal-to-metal support provided by the back-up ring allows a *calculated flow* of the resilient material. The clearance groove between the seat and disk is completely filled . . . the seal is *positive*, regardless of pressure.

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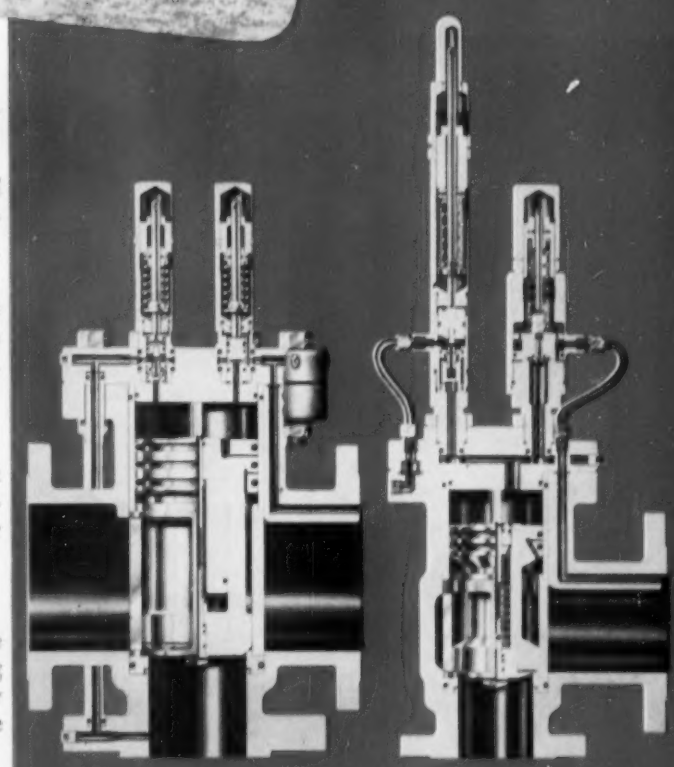

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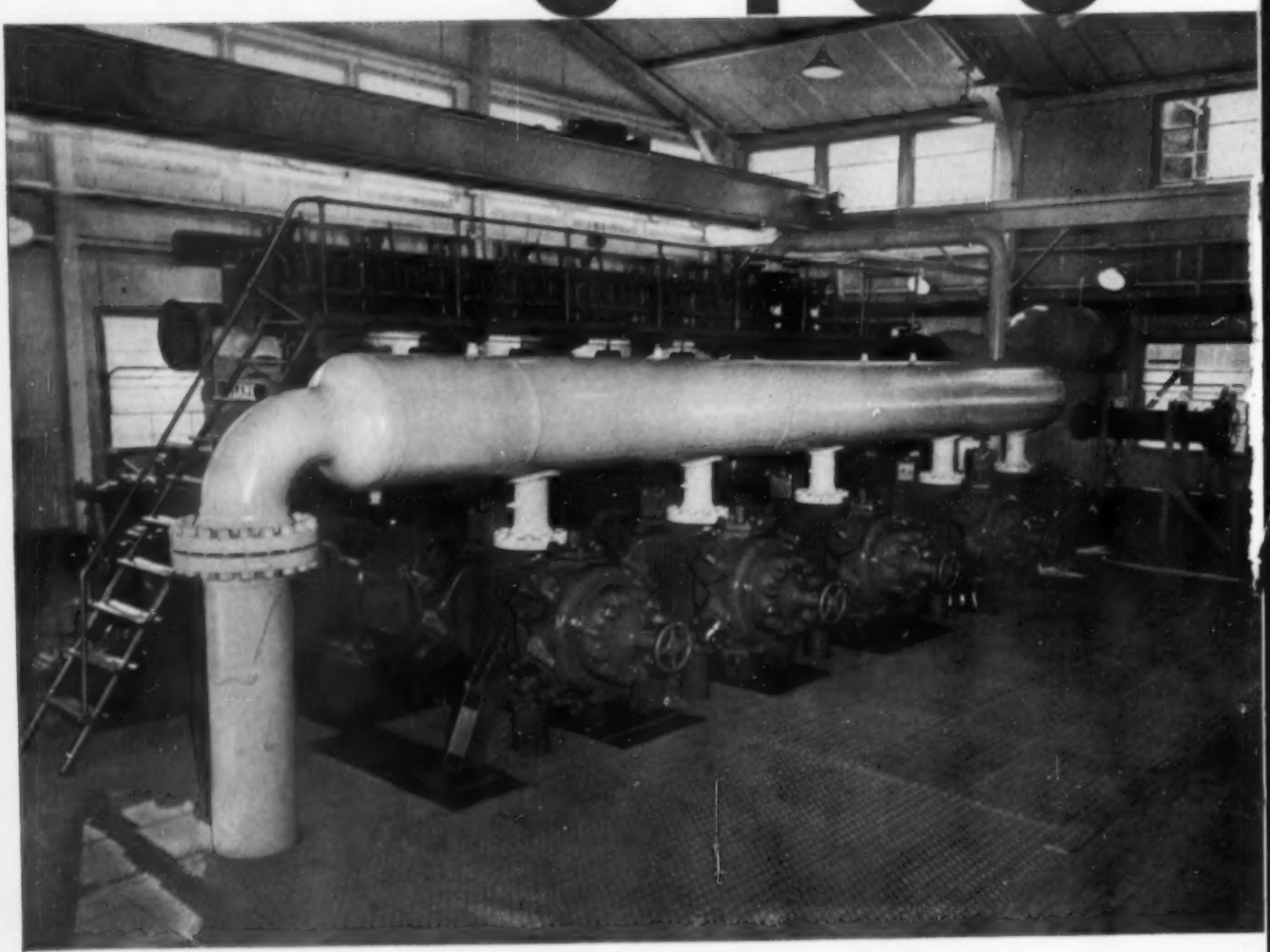

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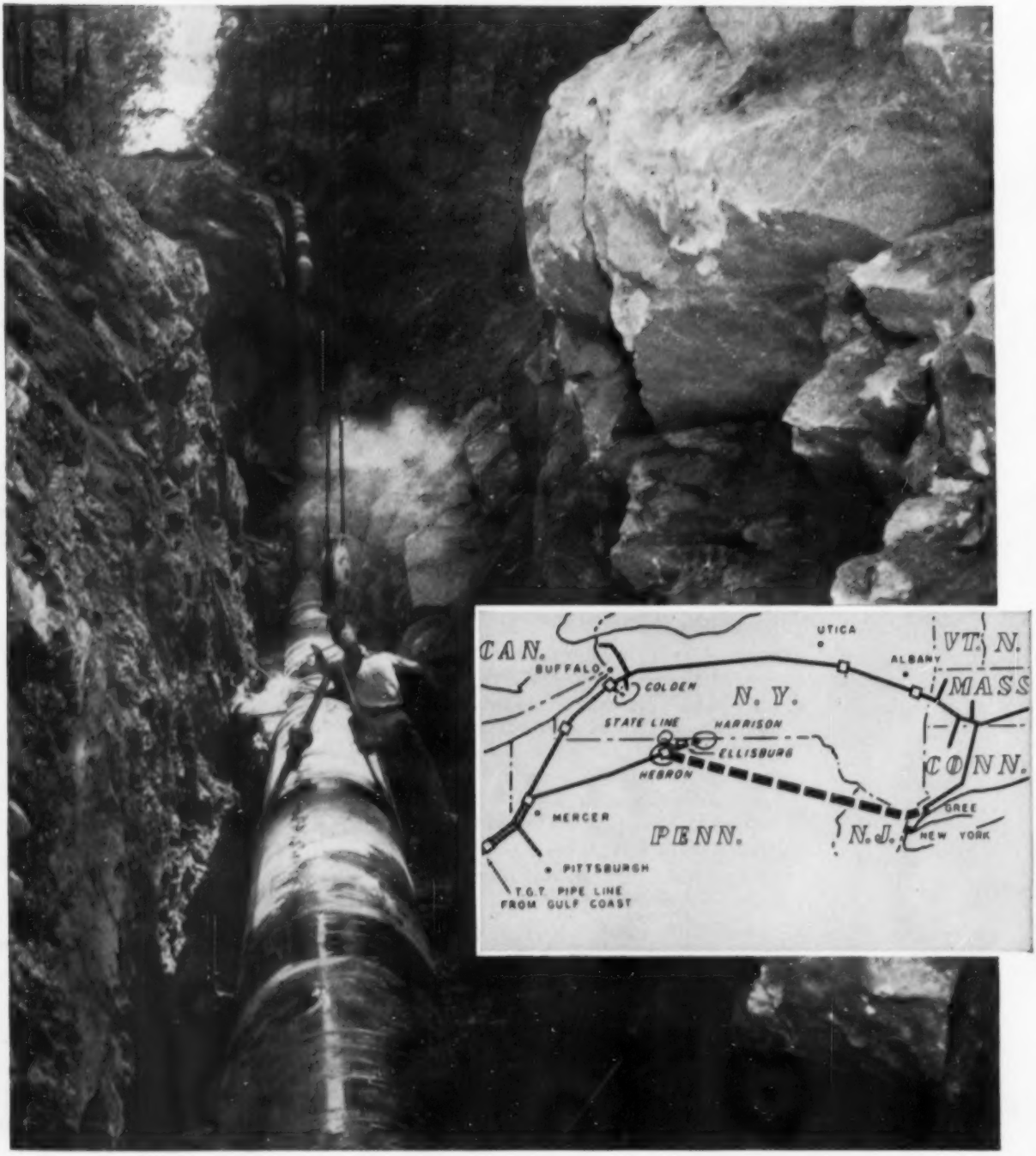

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Not only is National *Expanded Seamless* easier to weld at all temperatures, but it possesses greater, more uniform strength than ordinary line pipe. This high strength permits safer operation at high pressures under all conditions. And the uniform internal size of *Expanded Seamless* facilitates field line-up and welding. It is available in sizes 16-in. to 26-in. O.D., in a full range of wall thicknesses.

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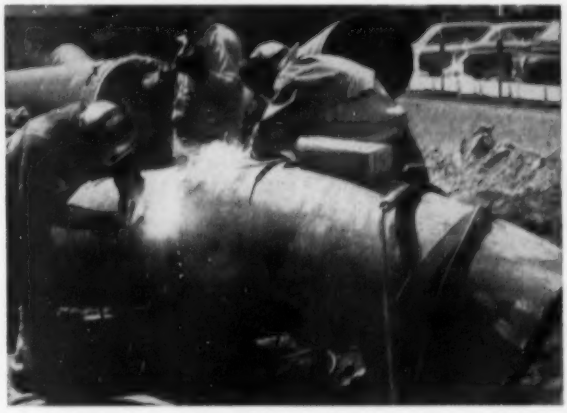
The pipe laid in the populated areas was yard-coated with coal-tar enamel, glass mat, and asbestos felt. Bending was accomplished by a bending machine at the yard.



Possessing superior welding characteristics, National *Expanded Seamless* in ½-inch wall was welded with five to six beads; in ⅜-inch wall with four beads. The pipe was delivered with a 30° bevel.

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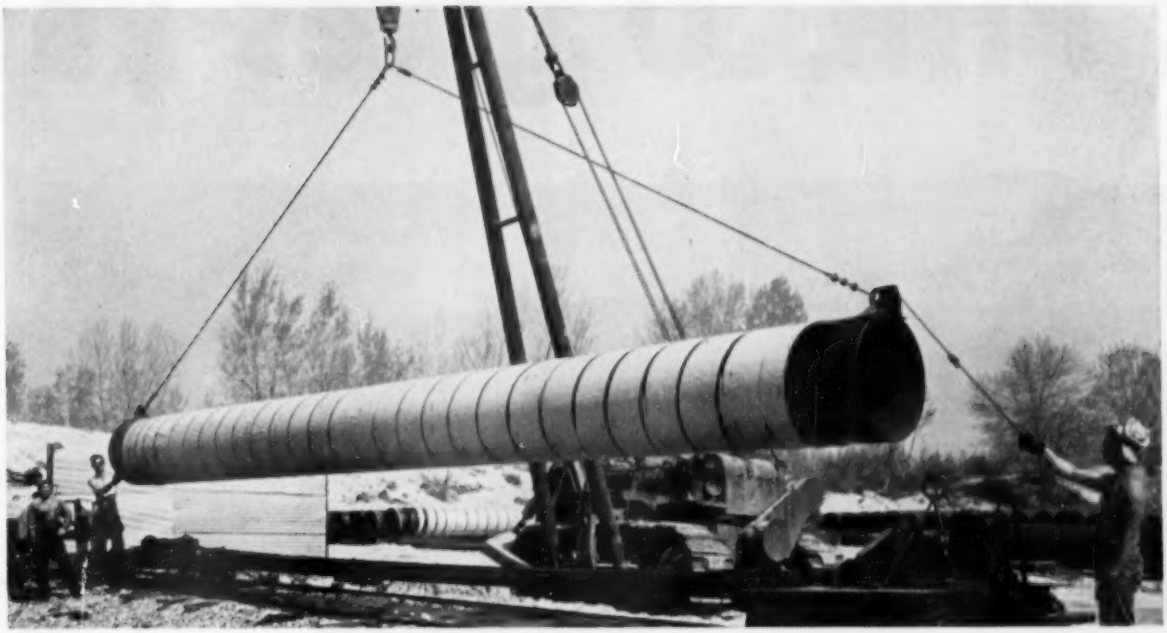
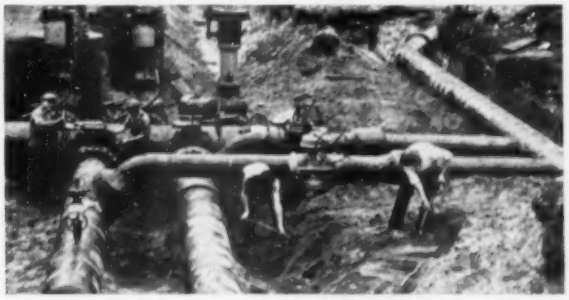
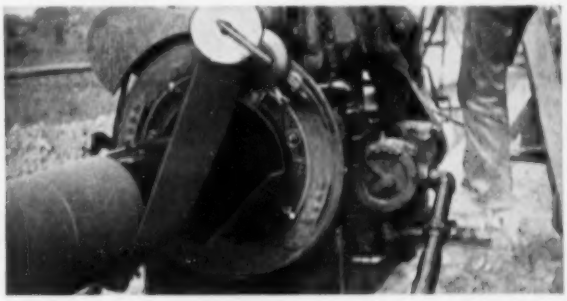


KING SIZE PROTECTION: 36" pipe, mill coated first with NO-OX-ID 6X for bonded insulation against moisture, then shielded with No. 7 NO-OX-IDized Wrapper and Service Coat for added electrical resistance and protection against soil stress. Finally, a kraft wrap to protect from damage in handling operations. This is long-term pipeline protection at its best.



WHERE ELBOW ROOM IS SCARCE: In crowded work space, No. 4 NO-OX-IDized Reinforced Fabric Wrapper is hand applied around irregular fittings such as valve manifolds on gas lines. No. 4 Wrapper, a coated fabric laminated to a plastic membrane, provides moisture-proof seal over pipe coating.



PROTECTION BY THE MILE: A NO-OX-ID coating combination is uniformly applied over-the-ditch by this traveling type machine. The NO-OX-ID 6X Base Coating is covered with an unbroken shield of No. 7 NO-OX-IDized Wrapper. The fabric side of the wrapper is an excellent surface for bonding a service coat.

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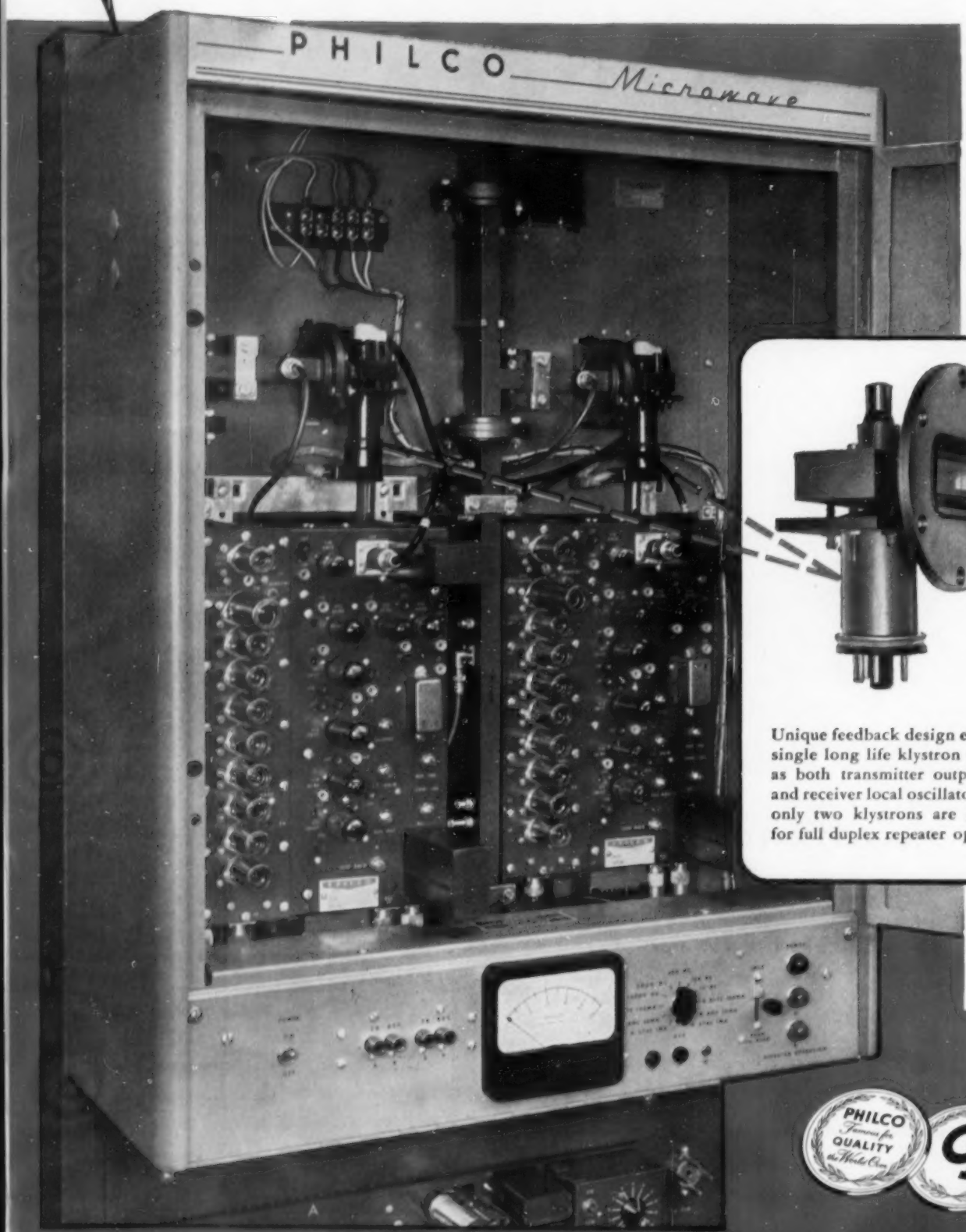

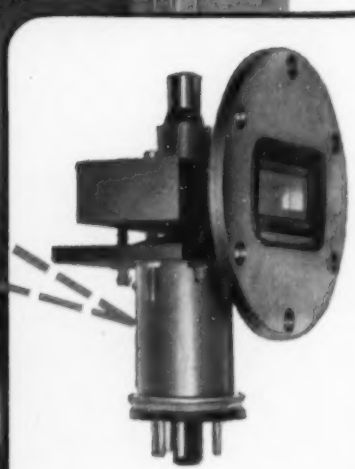

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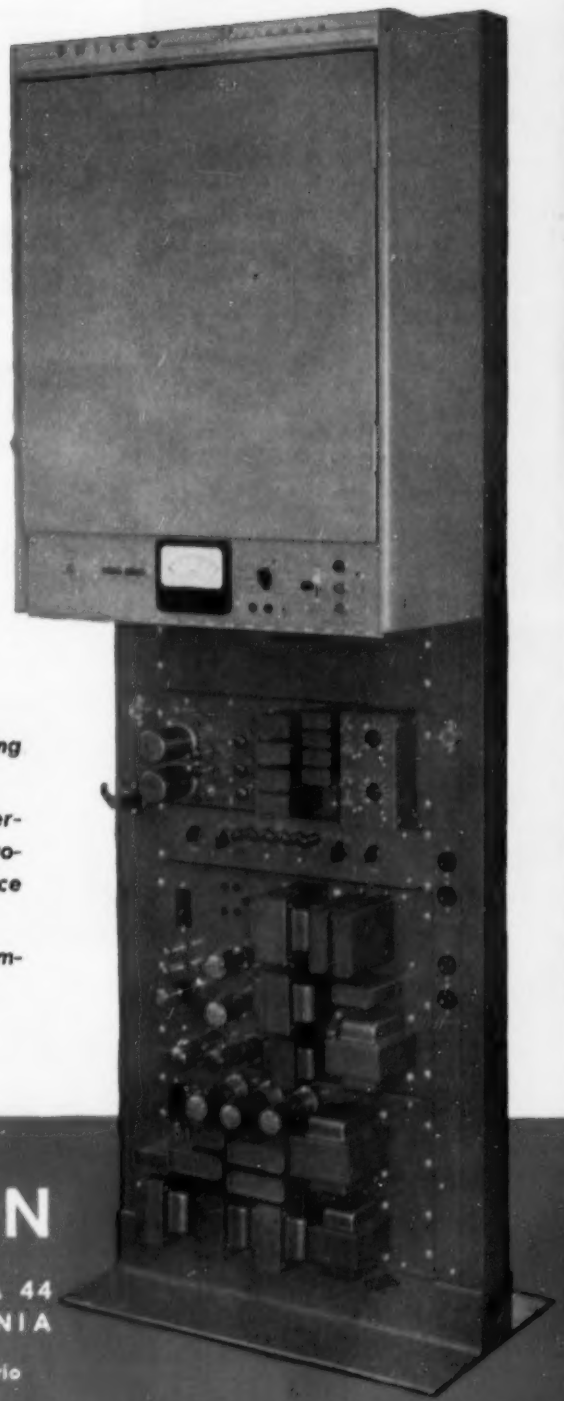

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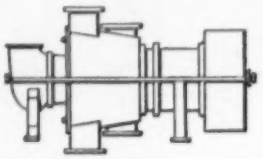

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GAS

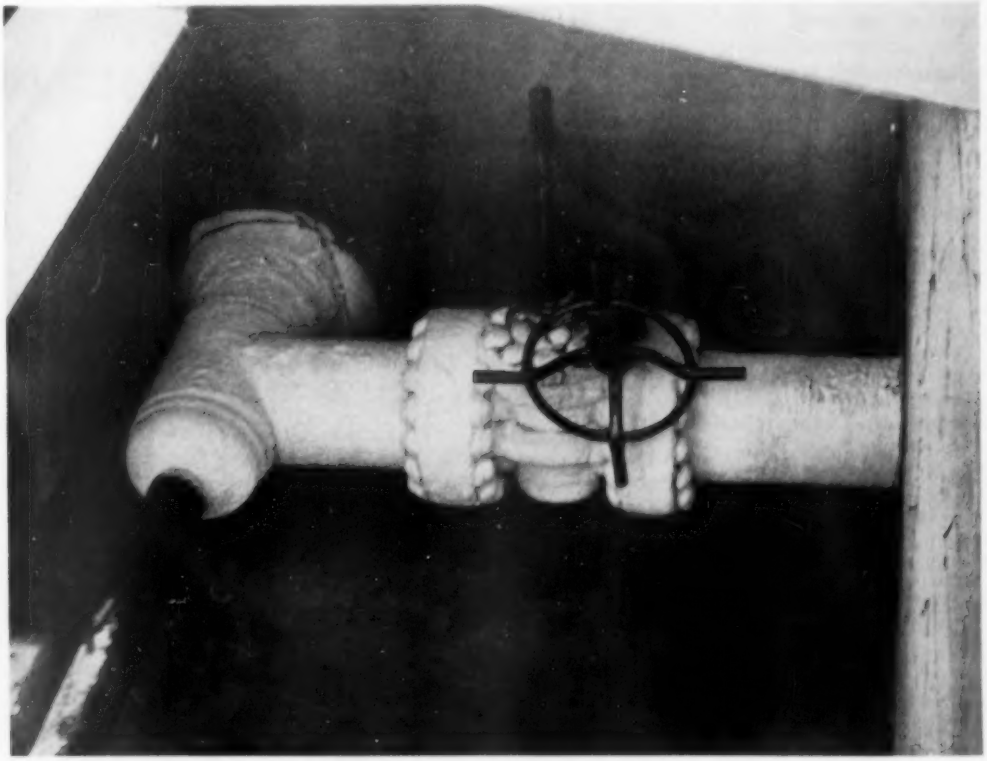
JUNE 1956

Prevention of freezing at metering, regulating stations

By **HOWARD S. GRAY** • Tennessee Gas Transmission Co., Houston

BEFORE the days of long line, high pressure gas transmission, a measurement man's worry of meter and regulator freezing was limited to the days of extremely cold weather. This was especially true because the volumes involved were generally small. Now, however, pipelines work with extremely high pressures originating in the fields of deep structures. As a result of improvement in materials and methods, gas streams are maintained at high pressure right to the town border stations, utilizing large diameter pipe and transmittting large volumes. As a result, the prevention of freezing in metering and regulating equipment has become a day-to-day problem, regardless of ambient temperatures.

Freezing may result from several different causes, and it is necessary to understand why the stoppages occur before we can undertake to remedy the situations. To maintain continuous



Frost and ice build up on a 10-in. plug valve. Rubber expansion sleeves were used where piping went through the valve box walls, preventing cracking.

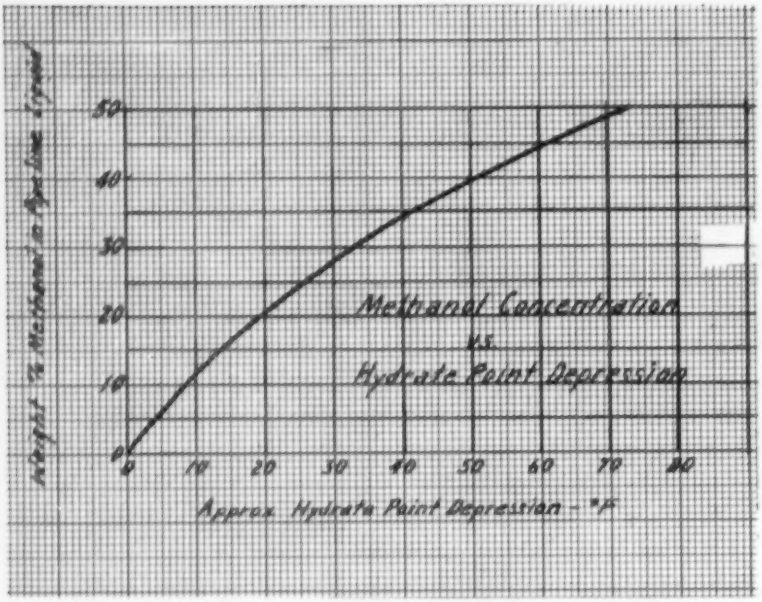


Fig. 1. Temperatures at which gas hydrates freeze at different pressures.

flow through our regulators and meters, we should know at all times the dew point of the gas involved and at what temperature formation of gas hydrates can be expected.

Meter and regulator station design engineers can help operating people tremendously by incorporating proven practices in their design. If it is necessary to deliver gas at reduced pressure without the addition of heat, then the following design features should be made in the piping makeup:

1. Provision should be made for floor drains to carry away the attendant moisture which forms on the cold piping;
2. Discharge piping should be carried through the wall and not through the floor or foundation;
3. An expansion loop of some type should be made in the discharge piping;
4. If it is necessary to go underground immediately downstream of pressure reduction, then all valves and fittings should be protected from the attendant stresses and strains;
5. All valve boxes should have adequate drains and piping should be provided with expansion type sleeves for tight seals.

A good "rule of thumb" to remember is that for each atmosphere of pressure reduction there is an attendant decrease in temperature of 1° F, or about 7° F per 100 psig cut.

GAS exclusive

Moisture can be found in almost all gases in the form of water vapor. Concentrations vary, of course, but there is a limit according to the temperature and pressure of the gas. Beyond this limit excess moisture takes the form of mist or fog. This water travels, of course, with the gas stream and collects in the low spots of supply lines and piping as well as in valve ports and against orifice plates. As soon as the weather starts to get cold, trouble can be expected.

Serious situation

Formation of hydrocarbon hydrates presents an even more serious situation. Certain gases can unite chemically with water to form hydrates at temperatures well above the normal freezing point of water. If line pressure is increased, then the temperature at which hydrates will form is increased also. Many stoppages in pipelines and equipment have occurred for this reason at temperatures well above 50° F.

Fig. 1 shows the temperature at which one may expect freezing of gas hydrates at different pressures.

Absorption type. Water-absorbing chemicals such as diethylene glycol, triethylene glycol, lithium chloride, calcium chloride, zinc chloride or glycerin, are circulated continuously through contactors, heat exchangers and reactivators. The choice of chemical used depends upon the dew point depression desired and the price and availability of materials.

The glycols are very hygroscopic and this characteristic has made their use widespread in industry. Diethylene glycol has been used successfully to dehydrate natural gas since the early 1930's, but triethylene glycol has been used only in recent years. The resultant dew point depression in a glycol dehydration plant depends upon the concentration of the solution in circulation and the temperature at which contact occurs.

Dry desiccant type. Dry disiccant type dehydration utilizes moisture adsorbent material in solid or granular form. Such desiccants as silica gel, activated alumina, activated calcium sulfate, activated bauxite or florite are a few of the better known. Dry desiccants give very good dew point depressions, but the drying units are cyclic rather than continuous.

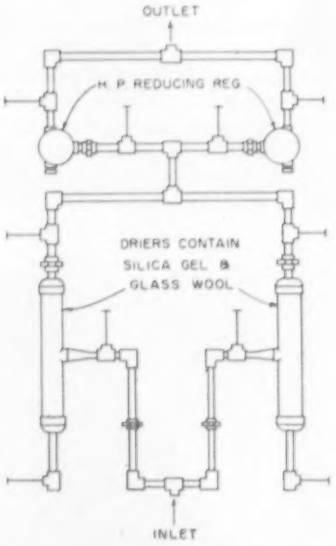


Fig. 2. Schematic drawing of desiccant-type dehydrators used in parallel ahead of pressure cuts to controls and regulators.

The water-sorption capacity of dry desiccants is usually expressed in terms of water adsorbed per pound of adsorbent or weight percent adsorbed. This capacity depends upon the following factors:

1. Mesh size of the desiccant;
2. Gas volume;
3. Temperature through the adsorption zone;

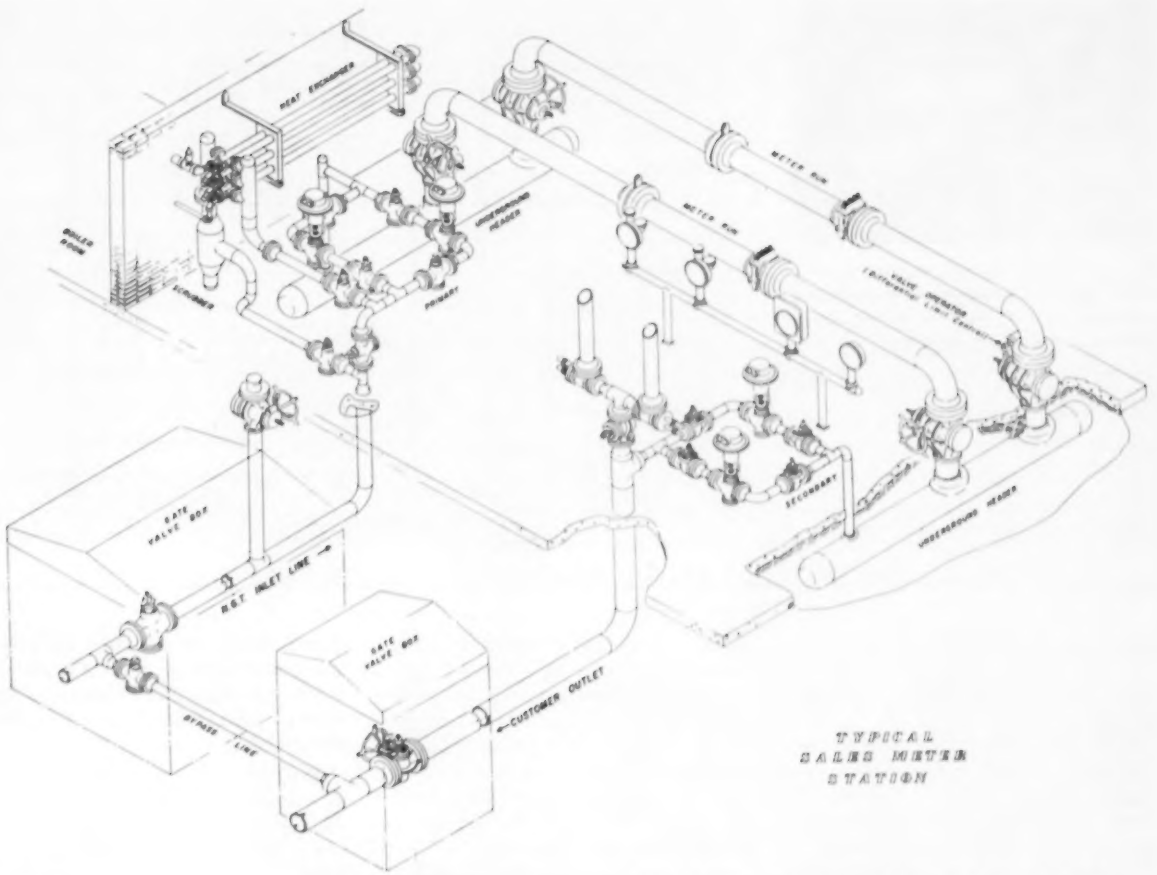


Fig. 3. Schematic drawing of meter station, showing separate piping and boiler rooms for steam or circulating hot water heating to prevent freezing. Through the use of "G" fin sections in the heat exchanger, gas stream can easily be controlled to any desired temperature.

4. Water content of the inlet gas;
5. General condition of the desiccant (i.e. degree of contamination by oils, etc.).

Desiccant type dehydration is very often used ahead of pressure cuts to controls and regulators. *Fig. 2* shows a simple arrangement of two such dehydrators used in parallel. One important advantage of this design is that continuity of service is assured by setting the outlet pressure of the two small regulators a few pounds apart. Small dehydrators of this type are often used in meter manifolds when measuring high pressure wet gas. It is absolutely necessary that all meter piping is leak-free to exclude the possibility of freezing.

Heating the gas stream at the location of the regulator station is by far the surest method of preventing freezing. There are three general catagories of heaters:

Direct-fired heaters and simple boilers. Direct-fired heaters are the most practical for use on gathering lines and small delivery stations. A simple boiler can be made of a short joint of large diameter pipe filled with water through which tubes pass to conduct the gas. The temperature can be automatically controlled with an element either in the gas stream or in the water itself. This type heater aids greatly in warming meter and regulator houses for the measurement engineer on cold days. House heaters are very beneficial in that the meter manifold temperature tends to equalize with the room temperature. Extreme caution must be utilized when operating direct-fired heaters as they must be 100% explosion proof.

Steam or circulating hot water heaters. The most desirable, although the most expensive, method is to actually run the gas stream through heat exchangers, transferring heat from steam or hot water boilers. Around compressor stations and gasoline plants such heat is readily available. However, in isolated meter and regulator stations, separate piping and boiler rooms must be provided. *Fig. 3* shows a design that is considered ideal by many engineers. Here, through the use of highly efficient "G" fin sections in the heat exchanger, the gas stream can easily be controlled to any desired temperature. The thermometer element is placed downstream of the first-cut regulator so that the regulated temperature is actually the same as the measuring temperature. It has been found by experience that the closed boiler system needs checking only at periods of one week or more. Either low pressure steam or hot water may be used in the closed-type system, but with hot water it is necessary to have a pump circulating the water continuously in conjunction with an overhead surge and makeup tank.

Electrical heating. Electrical heating has proven very successful for quick in-

Fig. 4. A typical portable methanol injector tank, such as this, can easily be connected upstream of any regulator setting where freezing conditions are occurring.

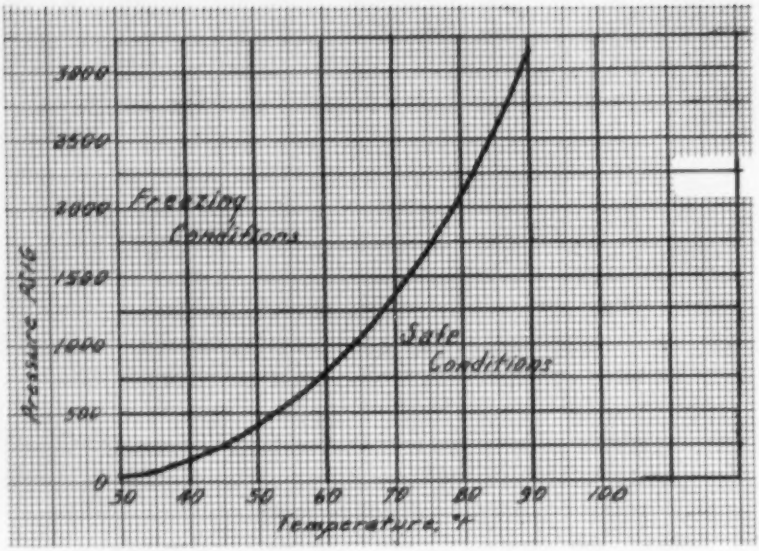


Fig. 5. Conditions for hydrate formation.

stallations whenever electrical current is available. The two most popular types are Calrod heaters and Cartridge heaters.

Calrod heaters are long, flexible elements which may be wrapped around piping inlet to regulators. Greater efficiency is accomplished by also wrapping the element with asbestos tape.

Cartridge-type heaters transmit heat from the cartridge through a metal case which completely surrounds the piping.

Emergency relief from freezing is best accomplished by injecting an inhibitor into the gas stream. An inhibitor is any substance which, when injected, will depress or lower the gas hydrate formation temperature.

The most commonly used inhibitors are ammonia, methanol and calcium chloride brine. Lately, the use of diethylene glycol for injection has become successful through the development of methods of recovery of the substances.

Ammonia is a very effective inhibitor, but it reacts with traces of carbon dioxide present in most natural gases to form ammonium carbonate. Ammonium carbonate will plug lines even faster than gas hydrates.

Brine solutions of calcium chloride work very well as an inhibitor, but its corrosive action on steel has caused it to be discontinued.

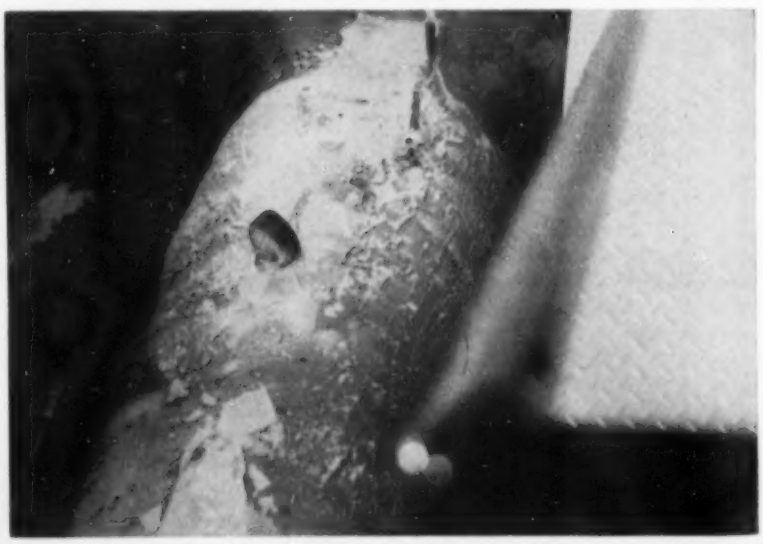
Methanol is best suited for controlling hydrate formations. It is non-corrosive, is soluble with water, does not react with any constituent in gas, is highly volatile and is readily available at reasonable cost. *Fig. 4* shows a typical portable methanol injector tank which can easily be connected upstream of any regulator setting where freezing conditions are occurring. A sight feed valve can be added to the feed line if the installation is to be of a permanent or semipermanent nature.

Fig. 5 shows the approximate hydrate point depression in degrees Fahrenheit versus weight percent methanol in pipeline liquid.

It is very important that the water vapor content of every gas stream is known. When the dew point and probable temperature of hydrate formation are known, it is easier to determine the type of precautions necessary to prevent freezing.

Routine schedules should be set up for the inspection of metering and regulating equipment to insure that all piping is clean and free from liquids and leaks.

Preheating the gas stream offers the best and most efficient results for "good housekeeping" and prevention of freezing in the equipment used to deliver gas to customers. ■



Solid ice has built up around this 10-in. plug valve. The valve has been rendered useless by ice that has practically covered the hand valve.

Southern California Gas deterges a mountain pipeline

By A. S. OLSON
Superintendent of Gas Supply

Southern California Gas Co.
Taft, Calif.

Cleaning out a stretch of 22-in. pipeline running through the Tehachapi mountains was more than just putting detergent and water in one end of the line, run pigs through, and remove the detergent and lots of material at the other end. The rugged mountain terrain forced Southern California Gas Co. to spend lots of time planning the operation. Here's how they did it.

A 22-in. pipeline stretches across the rugged Tehachapi mountains between Bakersfield and Los Angeles, transmitting gas to the metropolitan area of southern California from production fields in the San Joaquin valley.

The pipeline is part of a system Southern California Gas Co. has operated for the past 43 years. In 1912, the system was started with a single 12-in. coupled pipeline, 130 miles long, extending from Taft to Los Angeles. In 1920, the company paralleled it with another 12-in. welded line.

The section of the original 12-in. line across the Tehachapis was paralleled with a 22-in. line in 1829. (See *Fig. 1.*)

Southern California Gas Co. had cleaned the pipelines in the San Joaquin valley internally as conditions required, but no attempt had ever been made to clean the lines from the valley floor to the summit of the mountains since the lines were put in. Several leaks had developed in wrinkle expansion joints during the years. Considerable accumulations of foreign materials were found in the lines when the leaky sections were replaced.

A close inspection of the 22-in. line defined the limits of the foreign ma-

Fig. 1. This map shows the pipeline of Southern California Gas Co. which transmit gas from San Joaquin valley to Los Angeles. Arrow indicates stretch of pipeline that was deterged.

Deterging a pipeline... Controlling the pig in the mountains is difficult

terial to a 14-mile section through Grapevine Pass. This stretch of pipe rises rapidly from an elevation of 1700 ft to 4500 ft. Flow tests showed a low efficiency, indicating deposits in the line.

Immediate cleaning

The tests showed that the lines contained a considerable amount of material *(Fig. 2)*. It was evident that cleaning the line could not be delayed.

Before starting any major cleaning job of this sort, the first step is to prepare an estimate and get management approval to spend the necessary money. It was necessary to determine in advance the methods and procedures to be used. Previous internal pipeline cleaning jobs had been done in relatively flat country, using various types of pipeline pigs and a ball and chain crawler. In flat country, with relatively straight runs of pipe, control of these devices is not much of a problem. However, it was expected that controlling the pipeline pig in the mountains would be difficult.

The characteristics of the pipeline helped determine the kind of tools that were used. The line was constructed with Smith double-bell end pipe, arc welded with backup rings. Angles up to 3° had been made by inserting a plain end into the bell; angles 3° to 10° were Smith wrinkle expansion joints. Angles larger than 10° were Smith welding angles.

First step in cleaning the line was the decision to use a Chawner inflated ball and chain crawler. It was believed that the crawler *(Fig. 3)* would move the heavy deposits out of the sags and spread them on down the line, thus making the job easier for the pig which followed. Previous experience with the crawler indicated that best results would be obtained with the ball half filled with water and then inflated with nitrogen.

Fig. 2. Photograph of piece of pipe in line before deterging operation.

Obstruction

The crawler served another very important purpose. Because of its construction, it was thought that the pipeline might in places obstruct the passage of the pig. We felt, therefore, that if the crawler would pass through the pipeline there would be a good chance of being able to pig the line without having to hunt for stuck pigs. The Williamson UG-1 pipeline pig was selected for the cleaning job because it is short coupled for use in pipelines with sharp angles. This pig has two heavy rubber cups and 12 brushes *(Fig. 4)*. Mounted inside is a whistle which helps in locating the pig as it travels through the pipeline. The pig also has bypass nozzles which can be individually opened to permit more gas to flow through the brushes to keep them clean and carry the material ahead. During the few dry pig runs which were made in the cleaning job, one to four bypass nozzles were kept open. During the deterging operations, all bypass nozzles were closed.

As the pig fits inside the line very tightly, it was necessary to devise a method of inserting. To do this and to start the pig on its run, a special sender was constructed. The pig sender was made by cutting a 10-ft section of 22-in. pipe out of the line. The 10-ft section was placed in a cradle which extended down through the bolster pin holder of the truck. The pipe was then chained in place and a loose fitting sleeve, 24 in. in diameter and swaged to 22 in., was placed over the end. An underbed winch pulled the pig through the taper and into the sender. The pig and sender were then ready for installing in the line with bolted couplers.

Pig stopper

To stop the pig at the end of the section it was cleaning, a slotted type receiver was constructed. The receiver had 12 slots ahead of a compression chamber into which the pig came and compressed the gas ahead of it, forcing it to a stop. At the end of the compression chamber was a spring to help absorb the shock of the pig coming into the receiver *(Fig. 5)*. This slotted receiver worked very well, but because of other control problems, it was neces-

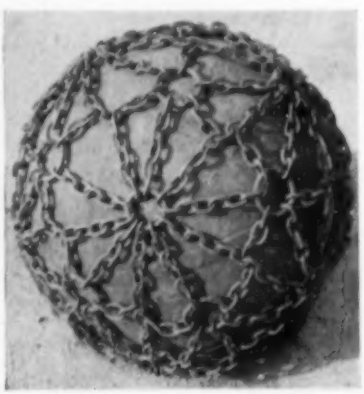


Fig. 3. This is the pipeline crawler used by SoCal.

This article has been adapted from a talk presented at the PCGA technical section gas supply and transmission conference held in Las Vegas, Nev., April 23-25, 1956

sary to build a gas-tight receiver. The gas-tight receiver used in the deterging operation was a short section of 22-in. pipe with a bull plug and a 6-in. connection off the bottom *(Fig. 6)*. This 6-in. connection was tied into a 6-in. valve that was throttled to control the pig in the pipeline. This receiver also simplified the problem of keeping air out of the line.

The final step in securing equipment to do the job was selection of a detergent. To determine the type of detergent to be used, a chemical analysis was made of the material found in the pipelines. This analysis was as follows:

	% by Weight
Oils	21.8
Water	3.0
Iron as Fe_2O_3	64.0
Silica	10.1
Sulfur as S	0.7
Sulfates	Trace
Chloride	Trace

Our laboratory tested numerous detergents on this material to find one which would emulsify the oil and disperse the solid particles to stay in suspension. Oakite No. 21, which was found to be an inhibitor and not detrimental to the pipe wall, was recommended in proportions of ½ lb to 1 gal. of water. The laboratory recommended agitation of the solution as it moved along the pipeline. This was accomplished during the deterging operation by permitting gas to pass through the pig and to bubble through the solution.

Second step

The second big step in planning the job was development of a plan and a profile, which were found to be extremely necessary to properly control the cleaning operation. Existing maps provided a relatively accurate plan of the pipeline. It was necessary, however, to survey the ground elevation over the pipeline and draw a suitable profile since accurate ones had not been prepared when the old lines were constructed. The plan and profile were used continuously throughout the job to determine where to place personnel along the line to spot the pig as it passed, to prepare a time table of the pig's expected progress through the line, and to determine the critical locations along the line where the pig could cause damage to the pipe.

For convenience and control, the entire job was divided into two sections, one 5 miles long and the other 9 miles long. In the 9-mile section, extending from Lebec to Grapevine and crossing U. S. Highway 99 four times, there is a difference in elevation of 2000 ft. The pipeline was cleaned downhill and in the opposite direction of the normal flow of gas. In preparing the line for cleaning, the mainline valve in the center of the section to be cleaned was replaced with a flanged spool.

Line ready

The pig sender and receiver were then installed and the line was ready for the cleaning operations. The first run was made with a ball and chain crawler. The crawler moved through the line with pressures of 2 to 6 psig, and 87 minutes later entered the receiver. No material came into the receiver. An exploratory run was then made with the pig. A solution of 1000 gal. of water and detergent was put in the line ahead of the pig to soften the material in the line during this run. Approximately 2600 gal. of material came out of the line at the receiver *(Fig. 7)*. The time for this run was 6 hours 39 minutes. Next the cleaning run was made. A solution of 3100 gal. of water and detergent was put in the line ahead of the pig. Approximately

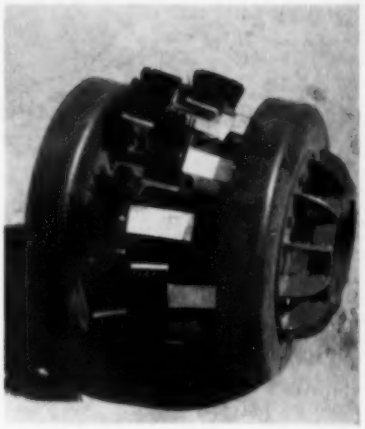


Fig. 4. A view of the pipeline pig used in deterging operation.

5200 gal. of material was recovered at the receiver. The last run was the rinse run and two pigs were used. The first pig was the same as used on the deterging runs. The second was a squeegee pig. Approximately 3700 gal. of water was put in the line ahead of the two pigs. Approximately 5000 gal. of fluid was recovered at the receiver.

This sounds like a simple procedure. We put detergent and water in one end of the pipeline, ran the pigs through the line and at the other end of the

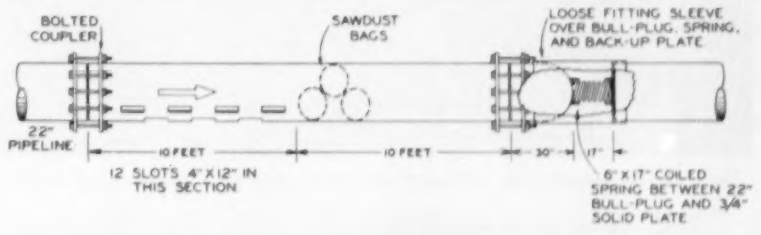

BOLTED COUPLER
SAWDUST BAGS
LOOSE FITTING SLEEVE OVER BULL-PLUG, SPRING, AND BACK-UP PLATE
22" PIPELINE
10 FEET
10 FEET
30"
17"
12 SLOTS 4" X 12" IN THIS SECTION
6" X 17" COILED SPRING BETWEEN 22" BULL-PLUG AND 3/4" SOLID PLATE

Fig. 5. Schematic drawing of the slotted receiver.

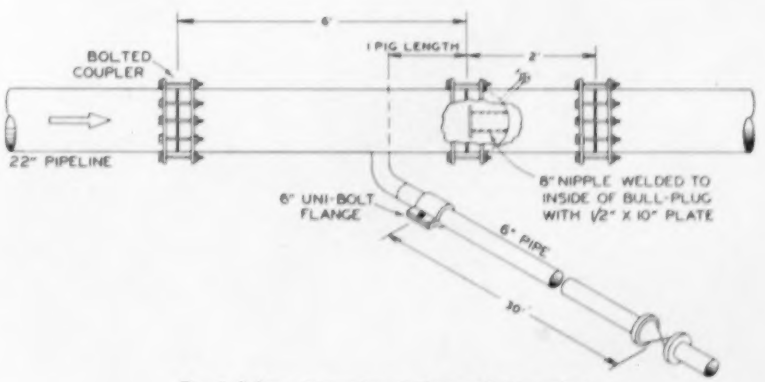


Fig. 6. Schematic drawing of the gas tight receiver.

Deterging a pipeline... An operating plan of each run was prepared before it was started

line removed the detergent plus a lot of material. It was not quite this simple, however. A major problem was controlling the pig. This required much planning and rather careful execution. The pig was controlled by a 2-in. bypass with a throttle valve around the mainline valve up stream from the pig sender and a 6-in. blowdown or stack valve at the same location which was used to lower the pressure behind the pig. In addition there was a 6-in. throttle valve at the pig receiver which was used to control the pressure in front of the pig and control its rate of travel. This was very important, because a dry pig will travel at high velocities and cause pipeline damage if allowed to run free. It was found that fluid ahead of the pig provided some braking action as it tried to accelerate. Before starting the cleaning operation, the plan and profile of the pipeline were carefully analyzed for the critical points at which the pig might become stuck. Also, the points of rapid change in elevation were located on the ground so that control changes could be made as the pig approached these locations to keep it under control if it started down a hill.

A detailed operating plan of each run was prepared before it was started. This plan included a step-by-step procedure for the work and also included a log sheet which was posted by the supervisor to check the rate of speed at which the pig was progressing along the line. The log contained an estimated time of arrival of the pig at each key point along the pipeline. A man was stationed at each of these points during the run and reported by radio to the supervisor immediately when he heard the pig pass his location. The supervisor gave orders by radio for necessary changes in the pressure upstream and downstream from the pig to maintain control. The log sheet also showed differences in elevation between the points so that the pressure required to move the pig could be checked against the calculated pressures to see whether it was stuck or whether it was moving according to schedule.

Fig. 7. This is a sample of the material recovered at the receiver during cleaning of pipeline.

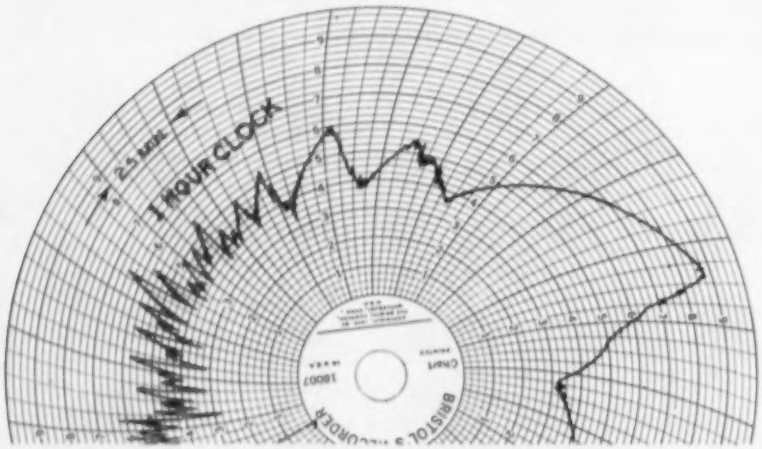


Fig. 8. Chart shows pressure used to push pipeline pig.

Pressure on pig

The 1-hour chart *(Fig. 8)* shows pressures behind the pig with a constant volume of gas entering the line behind it. As the pressure increased behind the pig, it moved a short distance through the pipeline and stopped, and then repeated this until a pressure was reached where it made a continuous run. The pressure then decreased, as shown on the chart, until there was insufficient pressure to keep the pig moving. This cycle was then repeated. The pressure gauge at the control location was watched continuously. As the pig approached a sharp angle, and if the chart indicated that the pig was on a continuous run, changes were made at the receiver and control locations so the pig would enter the angle at reduced velocity. Referring again to the pressure chart, under a different situation the pig was moving down the line with pressures varying from 3 to 6 psig. At the right side of the chart, the pressure rose from 4 to 9 psig with no pig movement as would be indicated by small pressure drops. For the control operator to continue to let the pressure build after normal pressures are exceeded, he has to know the location of the pig. If it is going up an incline, the pressure increase may be a normal situation. The 9 psig would have worried the supervisor had he not known that the pig was going up a hill and required additional pressure to reach the top.

Fig. 9 shows the profile of the pipeline at one location having an elevation increase of 90 ft in 300 ft of pipe. It was necessary to increase the pressure

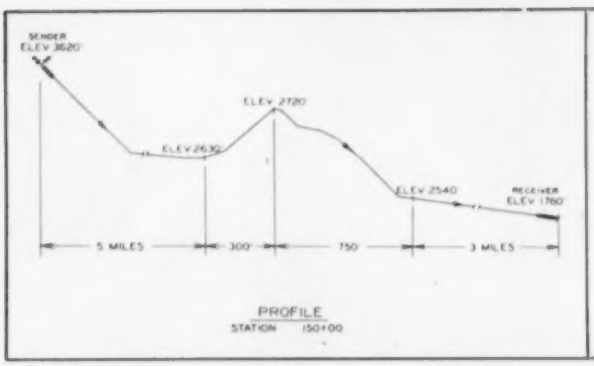


Fig. 9. Profile at one location along route of pipeline.

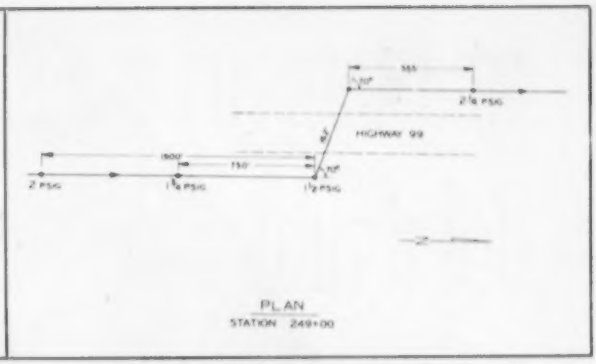


Fig. 10. Plan at one location along line, showing highway crossing.

behind the pig to 47 psig to move the pig and fluid up the hill. As the pig moved up the hill, the 6-in. valve at the receiver was closed. The instant the spotter radioed that the pig had moved over the top of the hill, the control gas was shut off and gas was stacked behind the pig. The pressure at the receiver was raised to 11 psig. When the pressure at the control valve reduced to 11 psig, indicating the pressure on both sides of the pig was equal, the stack was closed. No more gas was added to the system, and the pig was brought the next 2½ miles into the receiver by blowing gas at the receiver. Fortunately there were no sharp angles immediately downhill from the location where the pig had 47 psig behind it, otherwise this operation would not have been possible. Under those conditions, it would have been necessary to have the receiver closer to the foot of the hill which would have provided a higher pressure in front of the pig when it started downhill, or to have a large vent or stack at the top of the hill to lower the pressure faster behind the pig after it passed the summit.

Vertical angle control

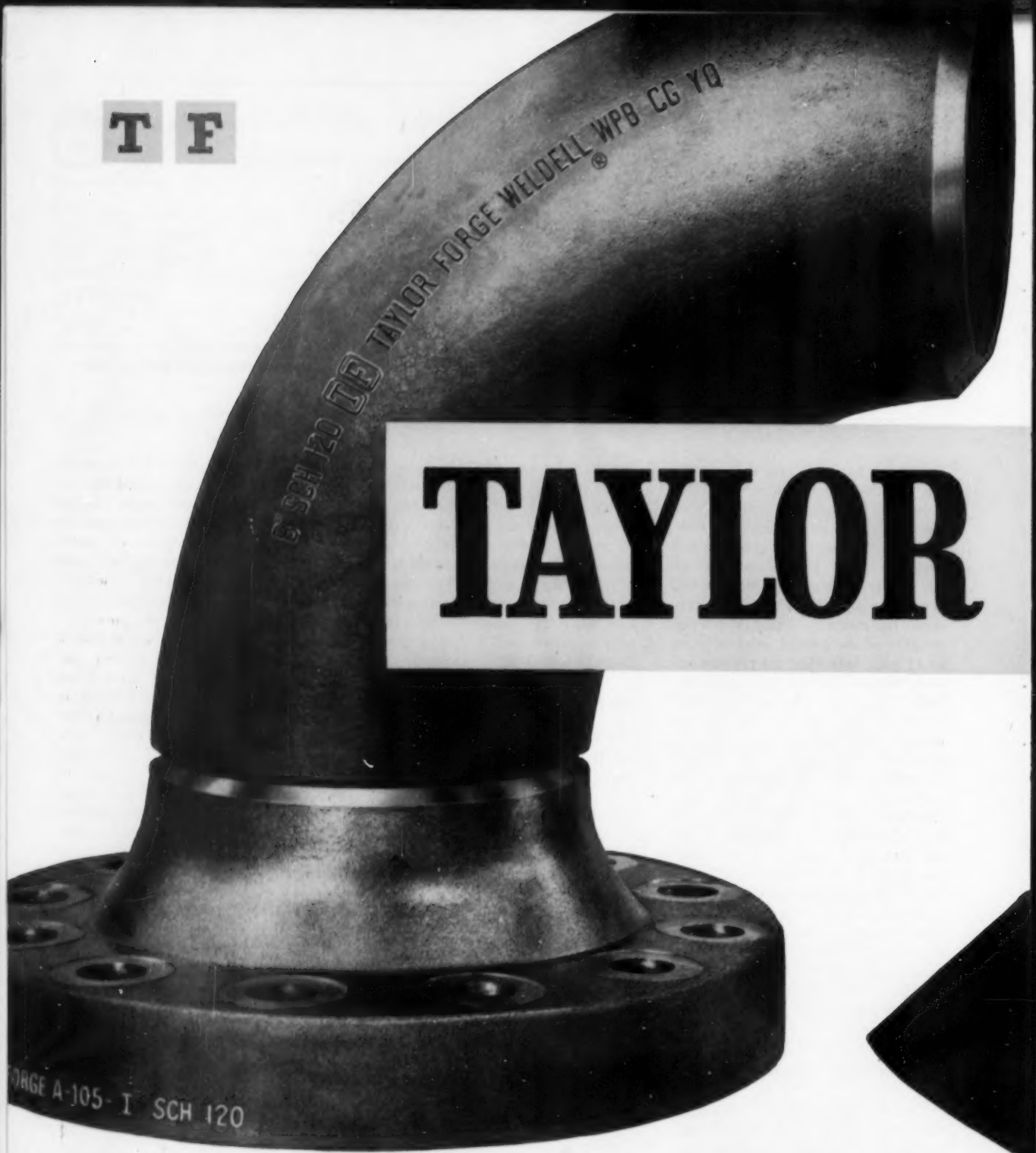
Control of the pig at vertical angles, of course, is one of the major problems in cleaning mountain pipelines. Another problem equally important, however, is the control of the pig at horizontal angles. *Fig. 11* shows the plan of the pipeline crossing U. S. Highway 99. In this crossing, the pig must traverse two 70° angles. At a location 1500 ft from the first angle, the pig was moving with 2 psig behind it. At that location the receiver was closed and the gas entering at the control location was shut off. One minute later, with the pig 750 ft from the angle, the pressure behind the pig was 1¾ psig; 30 seconds later at 1½ psig the pig passed the first angle. It was not heard as it passed the second angle because of the highway noise. Ten minutes later, when the pressure had been gradually increased to 2¼ psig, it passed the next spotter 555 ft away.

Amount cleaned

It is estimated that in excess of 400 bbl of material was cleaned from the line *(Fig. 11)* by running the pigs through twice. The line was thoroughly cleaned. Before cleaning, the calculated efficiency of this section of line was 71%. Following completion of the cleaning job, similar calculations indicated that the efficiency had increased to 92%. Not only do we feel that the results justified the cost of the job, but we were agreeably surprised that the cost was somewhat less than estimated. The direct cost of cleaning the 9-mile section of pipeline, which was the longest section of this line cleaned, was $650 per mile. A month later, using the detergent method, a 16-mile section of 18-in. line in similar terrain was cleaned for $263 per mile. We feel that the success in cleaning pipelines in mountainous territory depends on three major factors: selection of proper tools, equipment, and detergent; careful planning of the job; and careful control of the cleaning operation. The use of detergents in pipeline cleaning, both in flat country and in mountains, is a most successful way to insure clean transmission lines. ■

Fig. 11. Photograph of piece of pipe after deterging operation was completed.

T F



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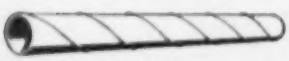
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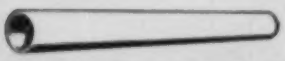
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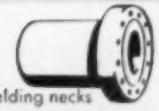
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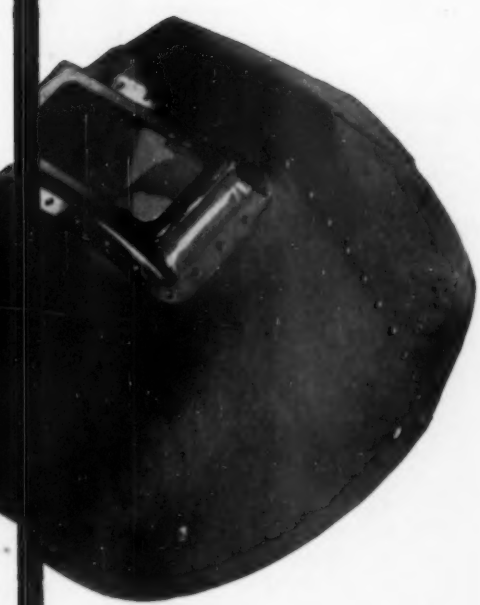

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New compressor station increases delivery to San Diego utility

One of the two 1100-hp natural gas engine-driven compressors installed at San Diego Gas' Moreno (Calif.) station. Many automatic controls have been incorporated in the station's design.

By JAMES JOSEPH

Two 1100-hp engine compressor units have increased delivery capacity of San Diego's 16-in. pipeline to 112 MMcf/day. The station is designed with an efficient jacket water cooling system and considerable sophistication in the control systems.

GAS exclusive

WHAT'S essentially a one-operator compressor station has just been put on the line, upping delivery capacity of San Diego Gas & Electric Co.'s 16-in. OD line (carrying Texas gas) to some 112 MMcf/d, compared to previous delivery of 83 MMcf/d. Behind this increase lies the utility's $800,000 Moreno compressor station and its two 1100-hp natural gas engine driven compressors which work on 450-psig suction pressure, a discharge of 650-psig.

Moreno compressor station is tied-in on 85 miles of 16-in. OD transmission line which hooks into Southern Counties Gas Co.'s pipeline bringing natural gas from Texas. A complex of deadman shut-offs, safety switches and monitors makes this one of the nation's most "automated" compressor stations now in use.

Physically, the Moreno station lies in Riverside county, along the 16-in. line about a quarter-mile south of its junction with Southern Counties' 30-incher. Thirty-five miles south of Moreno is San Diego Gas & Electric's Rainbow compressor station, where two 880-hp gas engine driven compressors deliver a maximum 83 MMcf/d, at a suction of 300 psig, a discharge pressure of 460 psig. Now, with Moreno hooked into the line, the 16-inch-

er's delivery will be substantially increased. Just as important, the 16-in. system now becomes a storage line of far greater capacity.

All this is indicative of San Diego's growth—and its need for natural gas. Before 1952, the 16-incher was delivering at normal pipeline pressures, without additional compression. Capacity then was a meager 40 MMcf/d. In 1952, Rainbow went on the line, upping delivery to 83 MMcf/d. Now, Moreno has become operative, compressing gas still further, and upping San Diego's delivery by another 29 MMcf/d.

Moreno's prime-movers are the two Clark 1100-hp supercharged gas engines which drive Clark compressors. Engines are two-cycle, right angle, with eight power and four compressor cylinders. Engines have a stroke of 14-in., a bore of 14-in. The 12.5-in. compressor cylinders have a manual lift valve at each end, and a clearance pocket on their outboard ends.

Engine-compressors are bedded in a compressor house that's physically isolated from the station's office, maintenance facility, and from the Waukesha gas engine-driven generator, which takes over in case of electrical failure. The standby delivers 150 kw via a synchronous generator. Isolation from main compressors eliminates need for explosion-proof switchgear in this area . . . a considerable saving.

In operation, the 16-in. transmission line is tapped by a 16-in. side gate, feeding gas to scrubbers. A 12-in. line can bypass the scrubbers, if desired.

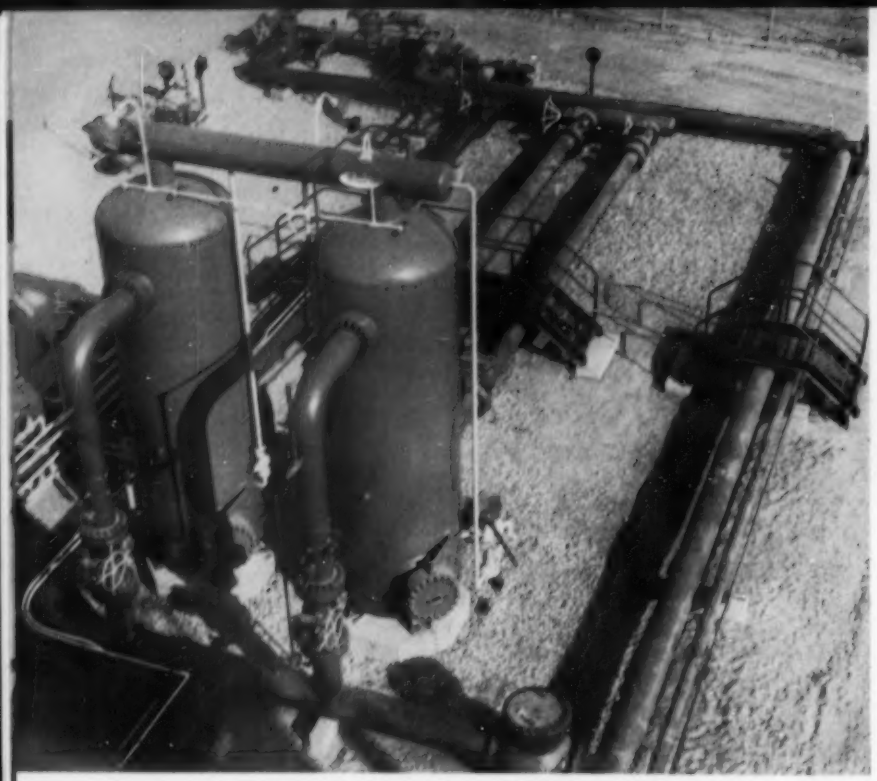
Gas is scrubbed by two, oil-type Blaw-Knox units, both 60-in. diameter and 17-ft high, working at a maximum 1000 psig. From scrubbers, a 16-in. suction header feeds the compressors, while a 12-in. header is tapped for fuel gas—operating compressor engines and the emergency electric plant. Compressed gas flows to a Fluor cooling tower, entering at 125-130°F and discharging at about 95°F. Gas then reenters the 16-in. line for transmission to the Rainbow station and, eventually, to San Diego.

Incoming Texas gas arrives at Moreno at approximately 60°F, and exits at 95°. The compression heat increase is only about 35°, which is not enough to affect either the transmission line covering growth or its coating and wrapping.

Each HSRA-8 Clark, 1100-hp gas engine drives a Clark 14- by 12.5-in. compressor. Compressors' suction bottles work at a maximum 850 psig, a maximum temperature of 615°F, are 30 in. OD by nearly 16 ft. The bottles were fabricated by Southwest Welding and Manufacturing Co. Engines are lubricated by McCord force-feed lubricators, the oil processed in Fram filters. Engine safety controls were furnished by Robertshaw-Fulton.

Jacket-water cooling is circulated in a closed system—one which San Diego Gas & Electric's engineers believe is the ultimate in efficiency. As a matter of fact, the single loop system so short cuts piping that it helped save the utility an approximate $5000 in construction costs. Essentially, water jacket cooling involves two Ingersoll Rand 600 gpm (at 1760 rpm) pumps, driven by 20-hp GE induction motors. The same line which carries jacket water also serves lube oil coolers. An 8-in. line runs to the Fluor cooling tower, where jacket water temperature drops about 10° (from 140° to 130°). A Fisher valve and regulator can, particularly on engine start-up, bypass the cooling tower (when engine water is cooler than, say, 130°F). The single loop continues its circuit to the lube oil coolers (mounted outside the compressor building). Jacket water entering the lube coolers at 130°F picks up two degrees, dropping lube oil from 160° to 140°F. Thus, jacket water, leaving engines at 142°, returns at 132°. This closed circuit is linked to

Building on the right houses the main compressor units, the auxiliaries are in the building at the left. Air filters, starting-air tanks, and lube oil cooler are in foreground.



Manifolding at the station side gates for the Moreno compressor station.

a surge tank. Make-up water is treated.

The isolated auxiliary room also contains two engine starting-air compressors. These are Gardner-Denver ADS, two-stage, V-type, air-cooled units, driven by 10 hp Century electric motors. Compressors work at 870 rpm, with a maximum 250 psig and a capacity of 31 scfm. Compressors have a bore of 5.5 in., a stroke of 4 in. Air start system's two storage tanks stand 10 ft high and are 36 in. OD, with a maximum 275 psig working pressure.

Combustion air is filtered through two Air-Maze oil bath filters, located exteriorly of the compressor house, as are the lube oil coolers.

The gas-fired auxiliary Waukesha engine, rated 150 kw, can carry the entire station and keep it operative, in case of a power outage. On the engine's right side is a four-cylinder gasoline starting engine, pull-cord cranked. The Waukesha (model 6NKRB) is equipped with an Ensign natural gas carburetor and regulator. Auxiliary engine's bore is 7 in., its stroke 8.25 in., and it operates at 1200 rpm. It directly couples to a 150-kw, 1200-rpm, 480-v a-c generator. The output is monitored by a Westinghouse Silverstat (model SRA) regulator. Auxiliary start-up, upon power failure, is manual.

One problem in tapping fuel gas from the incoming suction line involves reducing pressures from, for example, a maximum 530 psig to the initial fuel gas pressure of about 110 psig. Quick pressure reductions may result in hydrates, particularly when the weather is cold. Normally, fuel gas is tapped off the incoming 12-in. suction line, but during periods of cold weather or during high line pressures, where sharp reduction might cause hydrates to form, fuel gas is tapped from the discharge line. In either case, fuel gas is scrubbed.

Tapping the discharge during periods of cold picks up about 35°F over normal suction line temperatures. In either case, pressure reduction is the same. Fuel gas is carried to the engines (both compressor and auxiliary) where another pressure cut is made to the engine's operating pressure of 28 psig.

One wall of the station's control office is lined with the monitor board, which allows Moreno to operate single-handedly, yet safely.

The monitor board is equipped with: (1) a Panalarm system; (2) plant pressure-temperature instruments; (3) line monitoring meters.

The 10-indication Panalarm: (1) shuts down compressors if the cooling system fails to hold discharge gas to 95°F; (2) sounds an alarm if emergency gas reservoir's pressure falls below 115 psig; (3) shuts down both engine and compressor if cooling water temperature rises above limits; (4) shuts down engine if lube oil pressure falls to 25 psig; (5) shuts down plant if compressor output exceeds 830 psig; (6) shuts down engines if rpms exceed 350, indicating overspeed; and (7) warns of low line voltage, indicating need to switch to the auxiliary power supply.

The control panel's clock operates independently of either gas or electricity, is a 7-day hand-wound model.

Three Barton 24-hr orifice-meters monitor the plant. Two of these meters record the quantity of gas handled by the station. A third records fuel gas usage (in this, Moreno station is just another customer of Southern Counties Gas Co., in whose territory it is built). A fourth recording meter is a two-pen model which simultaneously records both suction and discharge line pressures.

Moreno boasts a dozen or more safety features, but two of them are of special interest. One involves a gas purging system which blows down the engines' exhaust mufflers before engines are started up. Blow down is triggered from a 250-psig starting air line. Air purges the exhaust stacks, ridding them of gas during time of engine start-up.

Another safety feature is the emergency shut-off, which not only blocks inflow of gas from the transmission line, but also blows down the station to atmospheric pressure via a 4-in. blowdown stack. System operates from the suction line which is tapped with a 1-in. feeder to a pressure-reducing valve working with a 150-psig storage tank. Two, three-way motor valves are controlled by eight remote stations at various points in the plant. Normally, the storage tank is valved closed. But, in case of emergency requiring shutdown, gas pressures reverse action on the motor valves and the tank acts to: (1) close the suction line; (2) close the discharge; (3) blowdown the entire station; (4) open the main 16-in. station bypass valve.

Thus, the compressor station is shut off and the main 16-in. transmission line opened to San Diego.

The Fluor Corp. Ltd. designed and built Moreno compressor station. Frank R. Bater is superintendent of the utility's gas department. Martin R. Engler is distribution engineer. Henry S. Farnsworth was project engineer for Fluor Corp. ■

GAS exclusive

Standby power units protect unattended compressor stations for Panhandle Eastern

When an automatic compressor station receives power from an REA system, the power outages are not frequent but they do occur. One of Panhandle Eastern's division electricians has developed an emergency power unit for automatic engine shutdown during periods of power failure.

By **WILLIAM R. ALLEN, Division Electrician** • Panhandle Eastern Pipe Line Co., Liberal, Kansas

THE production section of Panhandle Eastern Pipe Line Co. operates eight unattended, automatic compressor stations to move gas from wells. They are typical production type stations, but they must be provided with automatic shut-downs that will take the engines off the lines when emergencies occur in the engines' operation.

These compressor stations are relatively small. They range in size from the smallest station which has a single 300-hp unit to a station that has four 1100-hp engines. A typical station in this range has eight 300-hp and one 660-hp engines. The engines used are four-cycle Ingersoll-Rand XVG-8; two-cycle Cooper-Bessemer GMV- 6, 8, & 10; and two-cycle Clark MA 8. All are magneto spark-fired and are fueled with natural gas.

Safety devices are installed to control engine lubricating oil pressure, lubricating oil temperature, jacket cooling-water temperature, each compressor temperature, and station suction and discharge pressures. The control systems are designed to function on individual engines rather than on the station as a unit. Most of these stations compress field gas, so mist extractors with automatic dumps are provided. A safety control is operated by a float in the mist extractor to shut down an entire station if the automatic dump fails.

One station compresses production from sour gas wells. A sweetening plant has been provided at this station to remove H_2S. A control system sounds an alarm over a telephone system when the H_2S content in the flow stream reaches a control point as indicated by an H_2S recorder. When the H_2S content reaches a limit point, the control system shuts the station down. During this station's construction, one resident engineer remarked, "If you walk into the station with a bad disposition you'll shut her down."

Most of the control systems are designed around two-wire and three-wire Mercoid switches. When the control or sensing element operates, the three-wire switch grounds the magnetos to shut-off the ignition and the two-wire switch in a battery circuit activates to drop an indicator on an annunciator board which shows the point of trouble. *Fig. 1* shows a diagram of this control system. *Fig 2* shows the arrangement of the safety controls as installed.

The two-cycle engines are equipped with an air-operated, diaphragm motor valve in the fuel line. The activating air is shut off and the motor valve vented by the action of a three-way valve that is installed with its power element subjected to engine oil pressure. *Fig. 3* shows this system. On the four-cycle engines the fuel valve remains open until an operator arrives to shut it off.

These control arrangements have proven satisfactory and no accidents have been experienced; however, it is felt that shutting an engine down by killing the ignition system is very poor practice and it is a certainty that an operator would not do it in this manner. With this in mind, two of the stations were modified by equipping the engines with diaphragm motor valves in the fuel lines. Three-way, 110 v, a-c, solenoid valves are used to transmit control pressure to the motor valves. The three-wire switches in the existing safety controls were wired to operate the solenoid valves and annunciator drops as shown in *Fig. 4*. The system produces a much more desirable and safer method for shutting the engines down. *Fig. 5* shows a view of the annunciator box installation.

One of the two stations equipped with the modified control systems receives electrical power from a mainline compressor station and offers no problem from the maintenance of power supply. The other receives its power from an REA line and is located about

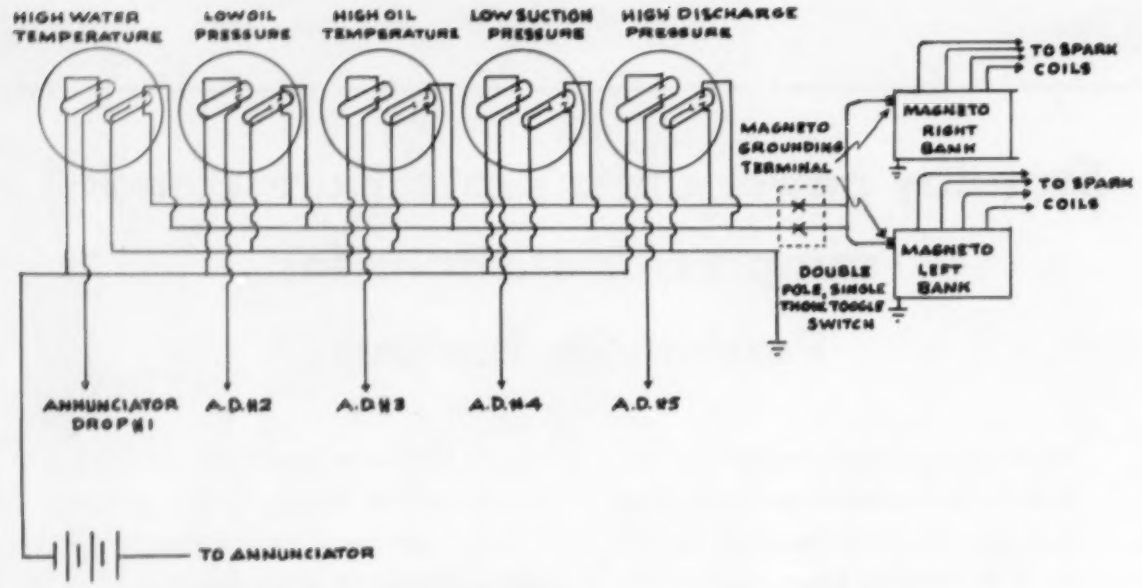


Fig. 1. Typical hook-up of safety controls to shut down compressor engine by grounding magneto ignition. The three-wire switches do the grounding function while the two-wire switches operate the annunciator drops.

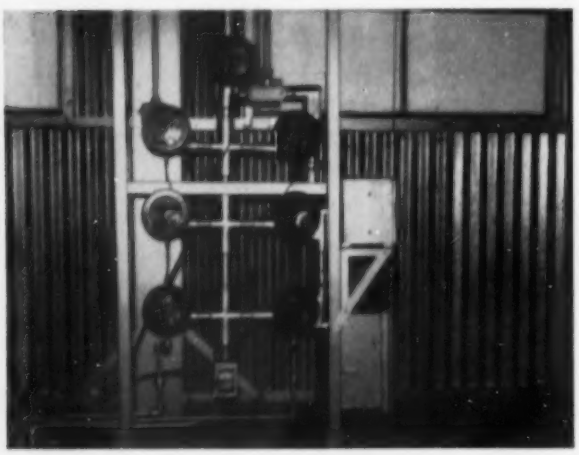
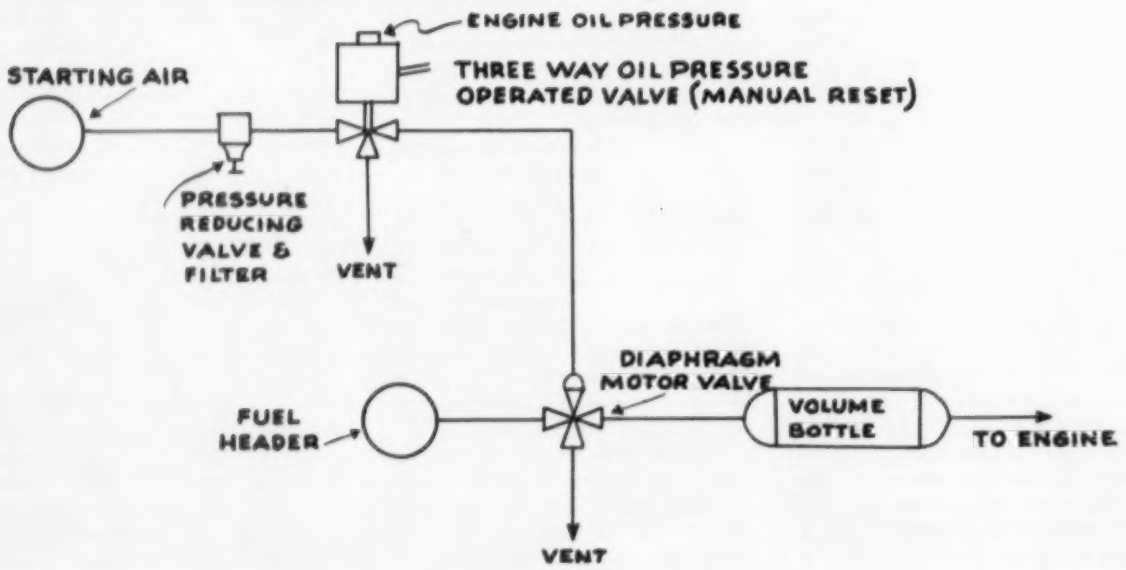


Fig. 2. A view of the safety controls and stand-by unit as installed in a field compressor station. Upper right-hand box contains a motor generator set. Lower box houses a storage battery.

Fig. 3. Schematic diagram of the control system to automatically shut off engine fuel when an engine is to be shut down. If low oil pressure happens to be the reason for shutting the engine down, ignition as well as fuel is cut off.



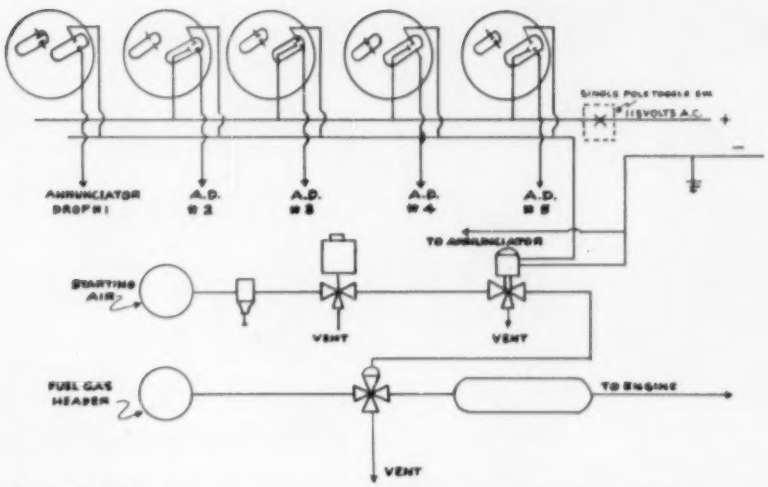


Fig. 4. The safety controls after they were redesigned to provide for shutting down an engine by cutting off the fuel rather than killing the ignition system. The two-wire switches were not needed, so were not used.

Fig. 5. Exterior view of a field compressor station showing the method of mounting and the location of the annunciator board (between the windows at the left).

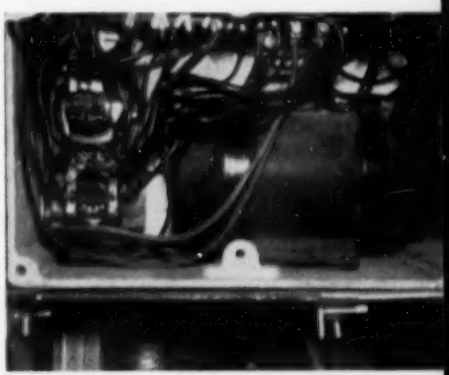


Fig. 7. Close-up view of the motor generator set. The two relays can be seen on the left.

35 miles from the generating station that produces the power. Power outages have been experienced at the latter station although they are not frequent.

A stand-by power unit was developed to assure shut-down of the station when the power fails in the REA line. Thus, full-time protection is provided. The stand-by unit consists of:

a 100 w, 6 v d-c to 110 v a-c, motor generator set;
a double-pole, double-throw, 110 v a-c relay;
a double-pole, single-throw, 6 v d-c relay;
and a 6 v storage battery.

A double-pole, single-throw, toggle switch is installed at each engine to isolate the controls while an engine is down, or to allow for maintenance and testing while the engine is in operation. Also, each engine is equipped with a pressure operated switch installed in the oil pressure gauge line to open the circuit should a pressure drop be experienced. The two-wire switch in the mist extractor was replaced with a three-wire switch.

Fig. 6 shows a diagram of the electrical circuitry in this control system. The 110 v, a-c relay gives supervision to the stand-by power unit when REA power fails. The supervision is surrendered by the stand-by power unit to the REA supply the instant power is restored in that source. The annunciator drop or indicator from the mist extractor had to be sacrificed in order for the mist extractor to serve either one or both of the installed engines.

Following through the circuit diagram, it can be seen that when the REA power is off, the motor generator set (See *Figs. 2 & 7*) does not run unless a safety control has operated to indicate an undesireable operating condition. If the motor generator set is called on to shut the engine down when the conventional power has failed, as soon as it has fulfilled its duty it is shut off. This saves the battery from unnecessary drain.

The power unit has functioned well under its designed operating task and conditions. On the basis of this successful experience, it has been included in the design of two new compressor stations that are now under construction. ■

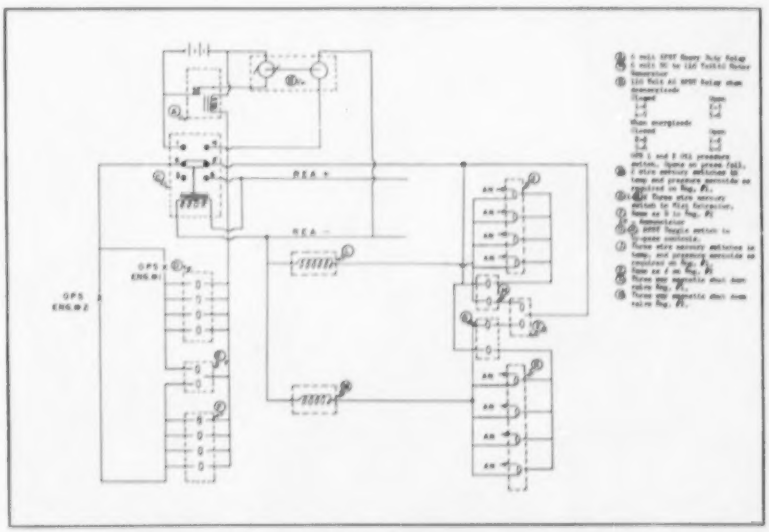


Fig. 6. Circuit diagram of the combined stand-by power unit and safety control system. The two-wire and three-wire switches have been separated in the diagram for simplicity.

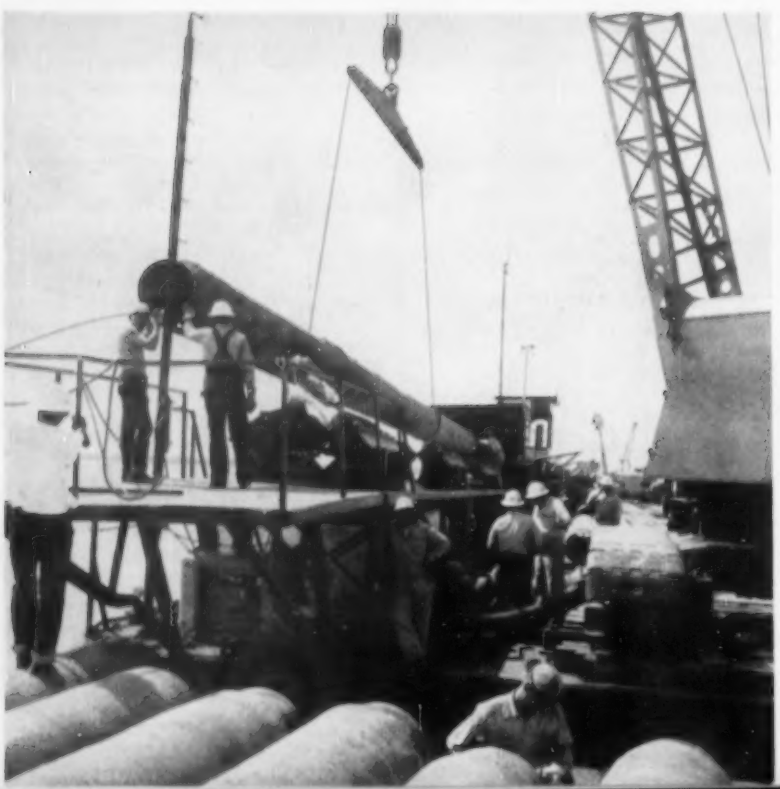
Dredges advance through Louisiana marsh digging canal for barges laying the Muskrat line. Canals are 40 ft wide and 8 ft deep. Pipeline is being laid in 4-ft deep ditches dredged along bottoms of canals.

Waterway is right-of-way for Louisiana gathering line

BARGE-riding natural gas pipeliners are splashing through a lonely, watery world of marshlands and swamps these days, laying the Tennessee Gas Transmission Co.'s new Muskrat line into prolific gas-producing areas of southeast Louisiana.

Length after length of massive, concrete-coated steel pipe is being lowered from pipe-laying barges into specially dug canals as the line, a 355-mile extension of the company's natural gas gathering system, progresses along the Louisianna coast. The 355-mile extension will stretch from near Crowley, La., where it will be tied in with an existing Tennessee Gas gathering line, eastward through the Louisiana lowlands to the mouth of the Mississippi river and into the Gulf of Mexico.

Nearly four-fifths of the gathering system extension—nicknamed the Muskrat line because of its geograph-



Crane swings double-jointed section of 24-in. pipe onto launching rollers aboard Williams Brothers pipe-laying barge during current construction of TGT's Muskrat line in southeast Louisiana.

Pipelining by barge is the order of the day as this Williams barge works on Lake Barre in Terrebonne parish, La. More than 100 navigable streams, lakes and bays will be crossed by the 355-mile pipeline system.

ical location—will lie under water. It is believed it will be the most extensive submarine gas pipeline in existence.

Construction began early in March and completion is expected by midsummer.

W. C. McGee Jr., Tennessee Gas senior vice president in charge of operations and construction, pointed out that the line will tap highly productive onshore and offshore areas which up to now have had insufficient market outlets.

These new gas supplies will be routed through the newly extended gathering system to the company's compressor station at Kinder, La., and from there on into the main transmission system, which stretches 2200 miles from south Texas into New England.

Waterway begins

Beginning near Crowley, the first 70 miles of the Muskrat line, which are under contract to Grayco Constructors Inc. and the Houston Contracting Co., involve normal dry land construction techniques. But from there on eastward the right-of-way becomes a waterway.

This underwater portion of the system—approximately 285 miles of pipeline ranging in diameter from 24 in. down to 4 in.—is being built under contracts let to Williams Brothers Co., Houston Contracting, Associated Pipe Line Contractors Inc., and Collins Construction Co.

Since the marshy lowlands cannot

Surveyor sights along marshy, grass-chocked route of the Muskrat line. Helicopters were used not only to transport survey crews and equipment, but to pull measurement chains from stake to stake through the marsh as well.

Steel pipe being used in the gathering system must be delivered by barge. The barges shown here are moving through the Intracoastal canal near Morgan City bound for a pipe yard where the pipe will be coated with a 2½-in. thickness of concrete prior to delivery to the construction site.

support standard construction equipment and since 139 navigable bodies of water must be crossed, pipelaying operations are being conducted from specially built barges equipped with cranes, welding stations and facilities for coating and wrapping the welded joints.

Forty-foot lengths of steel pipe, coated with a 2½-in. thickness of concrete, are delivered by water to the barges from pipe yards in Morgan City, Larose, New Orleans, and Harvey. The concrete not only provides a protective coating for the pipeline but also helps to anchor it under water.

Canals dredged

The pipe-laying barges are working in canals dredged through the marshlands specifically for the pipeline. These canals are 40 ft wide and 8 ft deep. The pipeline itself will rest in a 4-ft deep ditch dredged along the bottoms of these canals.

But at many points the pipe will be sunk to much greater depths: 100 ft at the Mississippi river crossing, 80 ft at Pass A'Loutre, 60 ft at the Atchafalaya river and 52 ft at the Wax Lake outlet channel. Crossing widths will range from just a few feet at smaller streams up to 7½ miles at Lake Raccourci, seven miles at Caminada Bay and six miles at Lake Barre.

This major extension of the company's Louisiana gas gathering system is part of Tennessee's $56 million pipeline and compressor construction program. Other portions of the program planned for 1956 include construction of 221 miles of pipelines parallel to the company's existing system in Kentucky and Ohio and the addition of compressor horsepower at new and existing stations in Louisiana, Mississippi, and New York. ■

The right-of-way is a waterway for about four-fifths of the system now under construction. A Houston Contracting barge is shown laying pipe near Morgan City. It is working in a 40-ft canal which was dredged especially for the pipelining operation.

New CRANE Double-Disc Valve

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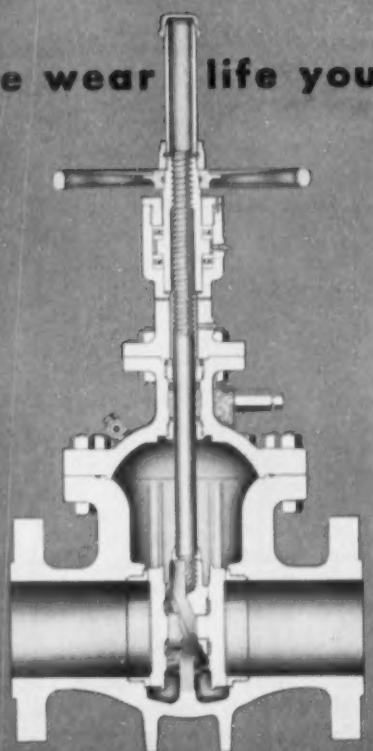

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Available in sizes 4 to 24 inches; flanged ends (No. 1680) or butt-welding ends (No. 1681). Either spur or bevel gearing can be provided. For full details, see your local Crane Representative or write to address below.

Developed for both oil and gas transmission, this new Crane gate valve has the long-wear features you want for steady, trouble-free service in your lines.

This new Crane valve design has free-to-rotate double discs—hung independently to change seating position with every operation. Each time this valve is opened or closed, both discs are free to turn to provide cleaning action on seating contact areas, and thus prevent abrasive materials from collecting.

Disc clearances are always accurate, because the two identical discs move up and down in machined body-guide ribs—which take the service abuse usually forced on disc faces in conventional double-disc gate valves, a frequent cause of damage and costly maintenance.

Consider and compare, too, the perfect disc alignment in this smooth-working Crane pipeline valve. Annular-shaped machined wedging surfaces keep both discs and the body ring seat faces lined up at all times—and, in addition, compensate for any slight body deflections caused by line strains.

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Fig. 1. A scrubber-regulator installation used by Mid-Continent Pipe Line to protect company-owned houses in case of gas interruptions or pressure failure.

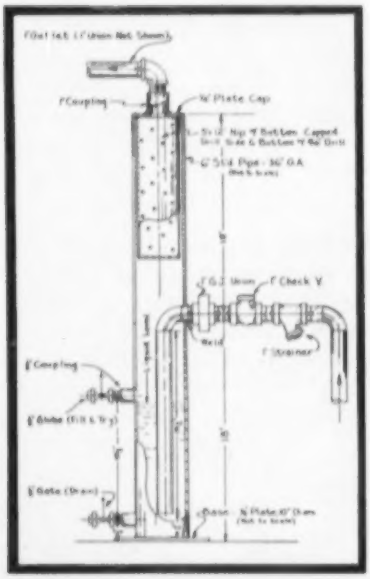

Fig. 2. Drawing showing design of the scrubber. A service regulator with under-pressure shut-off mechanism is installed downstream from the scrubber. Unit is charged with ethylene glycol and scrubs moisture, other liquid, and/or solid contaminants from gas stream.

GAS exclusive

Mid-Continent Pipe Line Co. develops gas scrubber-safety regulator unit

By D. W. VAN VLECK, Safety Engineer
Mid-Continent Pipe Line Co., Tulsa

All service lines to company cottages supplied natural gas from sources other than public utilities use this unique scrubber-regulator unit designed to prevent hazards due to pressure failure. Could you use this idea on your farm tap meter installations?

THE Mid-Continent Pipe Line Co., Tulsa, has eliminated explosion hazards of unexpected pressure failure in natural gas lines to company cottages served from gas sources without any guarantee as to the fuel's purity. Installation of gas scrubber—safety regulator units (see *Fig. 1*) in such service lines has eliminated the explosion hazards that had existed in a few instances in the past. Families residing in the cottages are now protected by the safety regulator shutting off gas service automatically when pressure fails. The regulator must then be manually reset before service is restored. In addition, the scrubber cleans the supplied gas, thus preventing clogged orifices in heating units and the monitoring mechanisms of the safety regulator.

The need for installations of this safety equipment was quite apparent during the winter of 1953-54, when several instances of gas failures were reported on lines serving company owned houses. Only those service lines from sources where gas is furnished without any guarantee as to purity caused trouble. Most of these lines are aboveground, and the gas contaminated with water; hence, the service is unreliable during cold weather when the water collects in low points in the line and freezes. The gas service also is subject to unannounced shut-offs, where the source is from an oil well or a residue line from a small natural gasoline plant.

The company management directed that steps be taken to rectify this trouble. Three service departments coordinated:

1. The safety department furnished general specifications.
2. The engineering department furnished design, size, and capacity requirements.
3. The mechanical maintenance department furnished design features for quick fabrication, installation, and inspection.

Excellent results were obtained from the cooperative efforts fo the three departments. This is evident in the simple design (see *Fig. 2*) of the scrubber-regulator unit, and the absence of reports on gas filled rooms during the year-and-a-half these units have been in service.

The scrubber-regulator units were designed to handle approximately 1 Mcf/hr, with a ⅜-in. orifice in the regulator and 10 psig supplied. Since none of the company houses have a load exceeding 75,000 Btu/hr, the unit has amply capacity and is not overloaded.

The unit was designed with the safety regulator installed downstream from the scrubber. This insures that only clean dry gas is supplied to the regulator. In this way, the regulator is not subjected to clogging effects of moisture and pipe scale. In addition,

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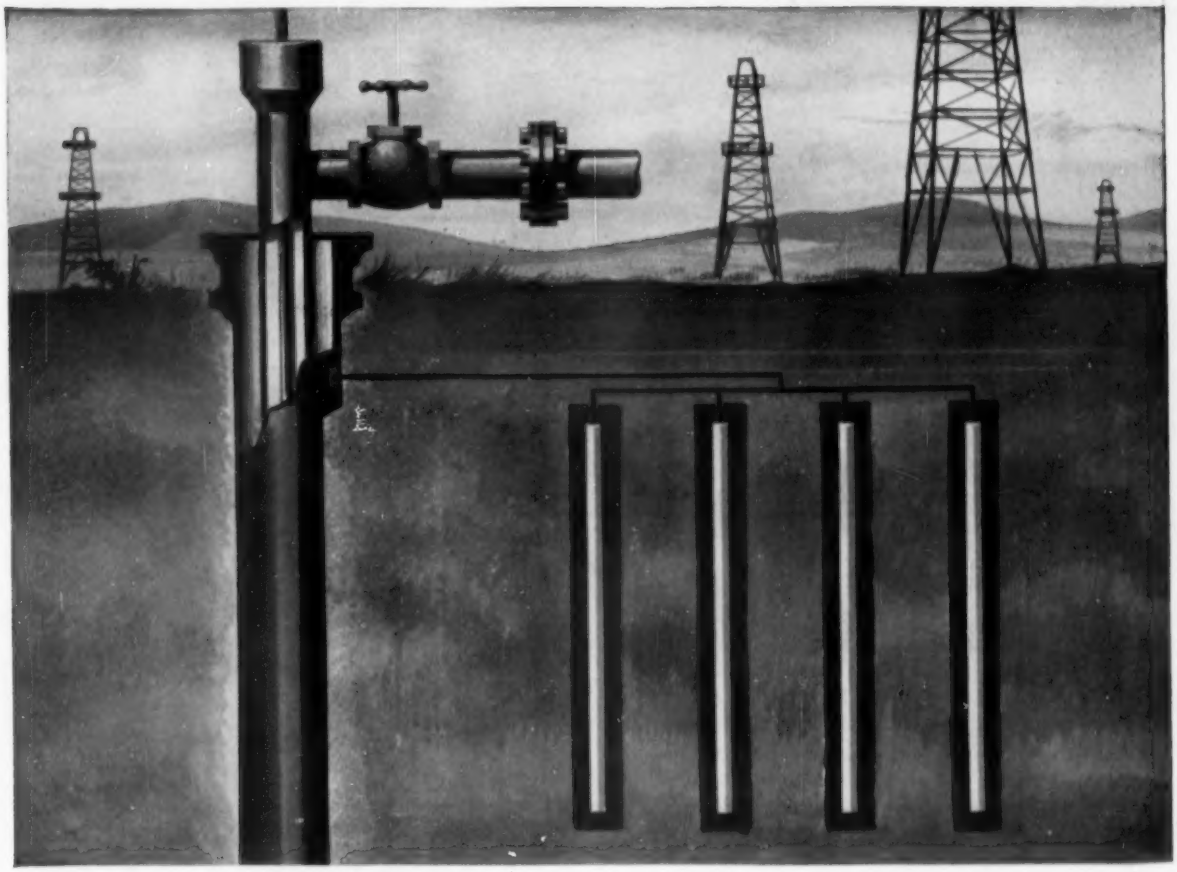

More initial current output. New Galvomag magnesium anodes substantially step up current; provide more efficient protection. Long ten-foot Galvomag anodes will produce up to three times as much current as conventional 17-pound anodes.

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Now you can give well casings and other underground structures the protection they need at a new low cost. High-potential Galvomag*, new magnesium anodes recently developed by Dow, generate more current—substantially more current—than conventional anodes. They provide effective protection with fewer anode units, thus reducing installation costs as well as maintenance costs.

Galvomag anodes are particularly beneficial in high-resistivity soils where large numbers of anodes were formerly required to provide the necessary protective current. The greater throwing power of Galvomag gives the extra punch needed for positive, efficient protection.

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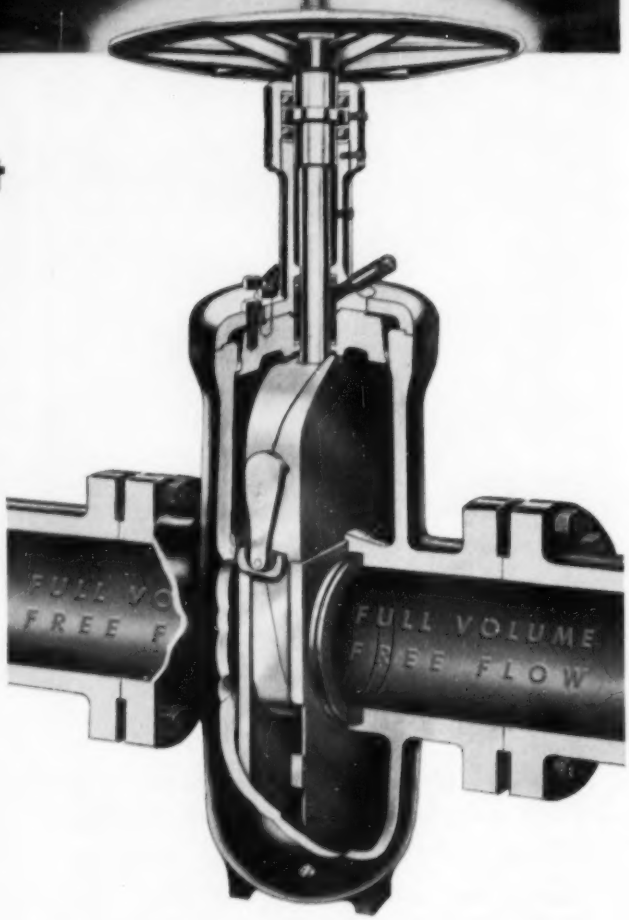

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¼-in. line taps were provided on each side of the regulator, so that maintenance tests may be easily and quickly performed.

The fabrication and installation costs of the units averaged $95 each. Installation was made by a maintenance foreman, who took units as fabricated from the West Tulsa shop and gave his full time to the installation assignment.

Company policy provided for installation of these units on all service lines from gas sources other than public utilities. The policy has become a construction standard, where a utility supply cannot be obtained.

An annual inspection system was inaugurated covering the following items:

A. Scrubber unit

1. Connection leaks.

All unions, couplings, plugs and other threaded connections tested with soap suds.

2. Glycol Stability

Top drain-valve is opened and the glycol level checked. If more than two quarts of diluted glycol is drained, the unit is recharged with fresh ethylene glycol.

3. Strainer

The strainer on the inlet supply pipe removed, and cleaned with naphtha if found to be dirty.

B. Safety Gas Regulator

1. Supplied service pressure

Downstream gas service supply is set to 6 ounces.

2. Automatic Shutoff

The safety function of the regulator is checked by closing the gate valve in the supply line, and allowing pressure to drop to zero. When gas supply is turned on, regulator must not pass gas until manually reset.

C. Inspections and Records

1. Responsibility

The inspections are a responsibility of the Safety Department.

2. Records

All records of inspection and corrective measures taken are kept in the Department of Safety.

No gas service trouble has been experienced during the one-and-one-half years these scrubber-regulator units have been in service. All families of employees residing in company cottages are protected against the possibilities of explosions from gas filled rooms, and employee morale has been considerably enhanced.

This intangible benefit is a direct supplement to the principal goal of the safety department: the improving of company-employee relations. ■

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Actuator Mounted
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QUAD units provide auxiliary manual hydraulic operation. The gas and oil systems in all Ledeen QUADS are completely separate, eliminating any gas-oil interface.

Features

- **Balanced torque delivered to valve stem through four-cylinder construction.**
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- **For periodic testing, detachable lever permits operation of actuator and controls without turning main valve.**
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GAS pipeline people

E. M. WELCH has been appointed southwestern district manager of Dearborn Chemical Co., and is in charge of a new district office opened recently in Dallas.

JOHN G. SEILER has been elected president of Tube Turns, Louisville, Ky., succeeding GEORGE O. BOOMER, who is retiring. Mr. Seiler has been vice president and general sales manager since 1945. He was elected a vice president of the parent company, National Cylinder Gas Co., at the time of his election to the presidency of Tube Turns.

ANDREW L. KOZAK has been named superintendent-manufacturing for General Electric Co.'s gas turbine department, Schenectady, N. Y.

WALTER H. DAVIDSON, who has been vice president and general superintendent of Transcontinental Gas Pipe Line Corp., Houston, has been elected vice president for operations. F. B. HAVERFIELD is the new general superintendent and HOWARD L. CLINE succeeds Mr. Haverfield as superintendent of compressor stations for Transco.

W. H. Davidson F. B. Haverfield
Transcontinental

ARNOLD ROBERTSON LA FORCE, former second vice president of Metropolitan Life Insurance Co., was elected financial vice president of El Paso (Texas) Natural Gas Co.

H. BEN YOUNG has joined W-K-M Manufacturing Co., Houston, as director of engineering. He was formerly with Mission Manufacturing Co., where he served for many years as chief engineer and director of overseas projects.

GEORGE ORR has joined Hill, Hubbell & Co. as southeastern district sales manager. He will serve a territory made up of West Virginia, Maryland, Virginia, Kentucky, Tennessee, North Carolina, Georgia, and Florida from his headquarters in Charleston, W. Va.

EDWARD N. BONNETT has been put in charge of a newly established Pittsburgh sales office of Roots-Connersville Blower, division of Dresser Industries Inc. Western Pennsylvania and the northern counties of West Virginia have been assigned to the Pittsburgh office.

HAROLD A. JONES has been promoted to national sales manager of Motorola Communications & Electronics Inc., Chicago. Mr. Jones was formerly executive assistant to the national sales manager.

JOHN H. CALDWELL has joined Pittsburgh Coke & Chemical Co. as a salesman in the firm's Protective Coatings division. He will handle sales in the Gulf states area.

Several personnel changes have been announced by Northern Natural Gas Co., Omaha. JACK W. SEAMAN is assistant superintendent of compressor stations, succeeding HUGH M. PENDLEY, who is now purchasing agent. JOHN J. FRANKS is director of a newly created processing section, which handles the operation of an electronic

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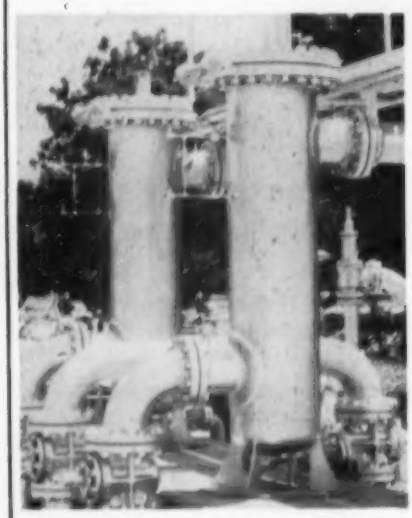

Sizes available are 4-inch through 18-inch diameter vessels for any working pressure.

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Capacity — up to 34,000,000 standard cubic feet per day.

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Scrubber is dry type. No oil carry-over to worry about.

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Filter medium is wool felt.

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Removes all particles 5 microns (.0002") in size, and larger.

Efficiency remains constant from very low flows to extremely high volumes.

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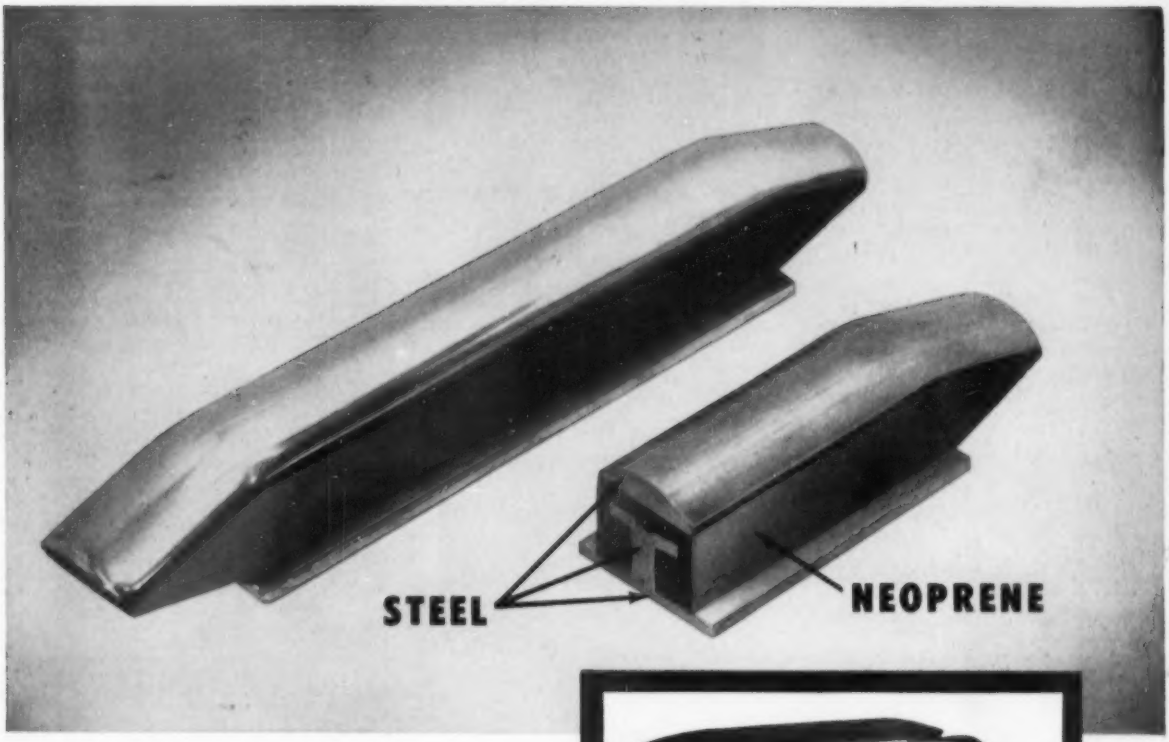
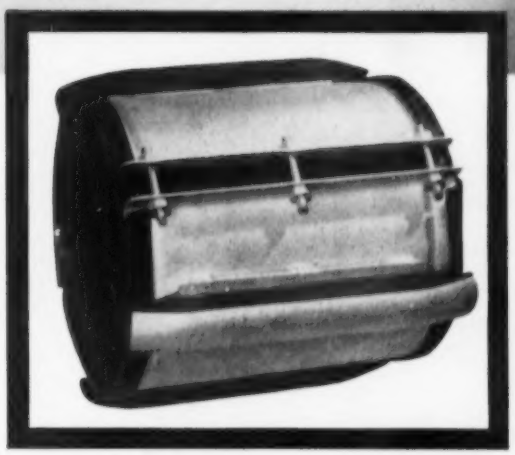


The Maloney Crossing Insulator With The Runners That Make Sense

The Maloney shoe is a new sled type. The rubbing surface is quarter round steel giving point contact with the casing which permits easy movement on installation. The long runners are tapered enough to let the carrier pipe slide over any casing welds that may be present. The tapered runners also facilitate easy entry of the carrier pipe into the casing.

Bonded metal-to-neoprene-to-metal on the runner insulates and also permits flexibility to compensate for pipe shifting and acts as a shock absorber to prevent damage due to sudden heavy loads.



"Something from the Irishman"

F. H. MALONEY *Company*

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LOS ANGELES TULSA

Since 1932
Precision In Rubber-Metal-Plastics

pipeline people • *Cont'd.*

digital computer recently contracted for by the company. F. D. STOCKMAN has joined the gas supply department of Northern as staff assistant and chief of service of the gas reserves and availability section, and JACK LEVERITT has joined the same department as field representative, working out of Midland, Texas.

E. L. MILLER has been elected to the office of assistant general manager of Cooper-Bessemer Corp., Mt. Vernon, Ohio. Mr. Miller will have responsibility for the overall operations of the company. The company has assigned RICHARD L. SPETKA to the New York domestic office.

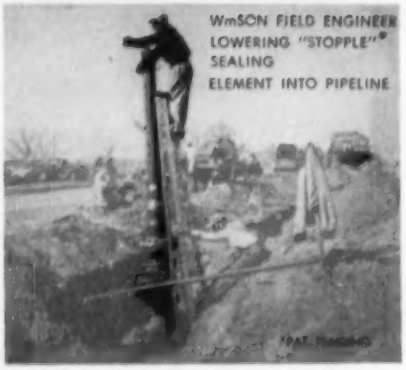
GAS progress reports

NEW CONSTRUCTION PLANNED

KANSAS-NEBRASKA NATURAL GAS CO., Phillipsburg, Kan. Docket G-10014 for 32.7-mile pipeline and 2700 hp additions at five compressor stations to increase supply to existing markets in Nebraska.

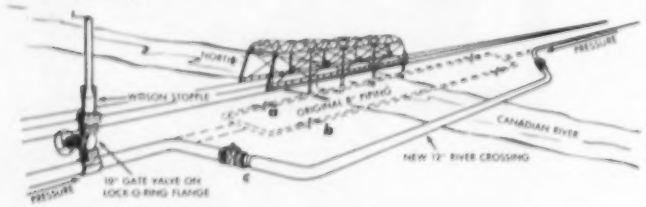
OKLA. NATURAL GAS RELOCATES 10" LINE *without* INTERRUPTION OF SERVICE

OKLAHOMA NATURAL GAS COMPANY MAINTAINED GAS SERVICE TO OKLAHOMA CITY CUSTOMERS WHILE RELOCATING A SECTION OF PIPELINE CROSSING THE NORTH CANADIAN RIVER . . .



HERE'S HOW THE JOB WAS DONE

① TWO 10" FLANGED SPLIT-TEES WERE WELDED TO THE LINE ON EITHER SIDE OF THE RIVER



② TAP WAS MADE WITH WmSON-HILLCO MODEL 660 TAPPING MACHINE

③ WmSON STOPPLE REPLACED TAPPING MACHINE ON CLOSED VALVE

④ LINE WAS PLUGGED ISOLATING SECTION BETWEEN STOPPLE AND VALVES a. & b. (CITY LOOP SYSTEM MAINTAINED SERVICE TO RIVER FROM EACH SIDE.)

⑤ ISOLATED SECTION WAS THEN CUT AND NEW 12" CROSSING TIED INTO 10" LINE

⑥ FOR REMOVAL OF VALVE, LOCK-O-RING PLUG WAS INSTALLED IN L-O-R FLANGE WITH TAPPING MACHINE

⑦ TAPPING MACHINE AND GATE VALVE WERE REMOVED AND BLIND FLANGE INSTALLED

THIS ENTIRE OPERATION WAS THEN REPEATED ON THE OPPOSITE SIDE OF THE RIVER

Write for RENTAL-PURCHASE information

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REPRESENTATIVES: Houston • Pittsburgh • Plainfield, N. J. • Amarillo • Casper • Provo, Utah • Joliet, Illinois • Los Angeles • San Francisco • Bartlesville, Okla. • Edmonton • Toronto Calgary • Buenos Aires • Durban, Natal, South Africa

CURRENT CONSTRUCTION

AMERICAN LOUISIANA PIPE LINE CO., Detroit. Docket G-2306 to construct 1289 miles of line—30-in. from North Tepetate, Acadia parish, La., to connect with Michigan Consolidated facilities near Detroit; 24-in. to feed into 30-in. line in Louisiana; also three 10,000-hp compressor stations. Brown & Root has laid 73 miles, Houston Contracting 142 miles, H. C. Price 156 miles. All major river crossings are complete. Completion is scheduled for June 1956 and project is on schedule.

ARKANSAS LOUISIANA GAS CO., Shreveport. Docket G-2307 for 134 miles of 6⅝- to 24-in. line in 11 sections, and 10,500-hp compressor station on its system in Arkansas, Louisiana, and Texas. Compressor station and 71 miles of line completed.

COLORADO INTERSTATE GAS CO., Colorado Springs. Docket G-2121 - (1956 program) 239 miles of 22-in. line from Laramie, Wyo. to connection with Pacific Northwest Pipeline Corp. line at Green River, Wyo.; with 4400-hp compressor station near Green River. R. H. Fulton will start two spreads April 15. Completed by Nov. 1.

NEW YORK STATE NATURAL GAS CORP., Pittsburgh. Docket G-9860 for 27-mile extension of existing line to extend line from Elk county, Pa. to new Luthersburg gas field in Clearfield, Jefferson, and Indiana counties, Pa. Harford Brothers started construction April 2. Completion scheduled for June 15.

PACIFIC NORTHWEST PIPELINE CORP., Houston. Dockets G-1429 and 8932 et al for 1487 miles mainline; 443 miles of spur and lateral lines; and 13 mainline compressor stations totaling 83,500 hp and 2 booster stations totaling 4620 hp, to extend from Ignacio, Colo., in the San Juan basin, to Sumas, Wash. (Canadian border). Fish Northwest Constructors Inc., builders of the line, have let contracts to River Construction Corp., R. H. Fulton & Co., Associated Pipeline Contractors, A. J. Curtis Construction Co., B. & M. Construction Co., Midwestern Constructors Inc., H. B. Zachry Co., and Fulghum Construction Co. for first 1061 miles. Completion scheduled for fall of '56. As of Jan. 1, about 691 miles of mainline and 163 miles of gathering and lateral lines had been lowered in.

PERMIAN BASIN PIPELINE CO., Omaha. Docket G-9688 and 9724. For 19-mile, 16-in. line and 6750-hp compressor station in Andrews county, Texas, to take gas from Phillips gasoline plant. Gasoline Plant Construction Corp., Houston building compressor station; R. H. Fulton the line.

TEXAS EASTERN TRANSMISSION CORP., Shreveport. Docket G-2503. Three compressor stations remain to be completed.

TEXAS GAS TRANSMISSION CORP., Owensboro, Ky. Docket G-8828 for 189 miles of line and 19,190 hp in compressor capacity along its system in Louisiana, Arkansas, Mississippi, Tennessee, Kentucky, and Indiana. Contracts for 10,820 compressor hp let to Longview Equipment Co. and 7500 hp to Ford, Bacon & Davis. Compressor construction begun. Work completed on 15.14 miles of pipe, contracts let on remainder to Houston Contracting Co., Williams Brothers Co., and Union Construction Co.

TENNESSEE GAS TRANSMISSION CO., Houston. Docket G-2534, et al, to build approximately 220 miles of 26- and 30-in. mainline loops paralleling its system in Kentucky and Ohio; installation of 12,540 hp additions; and 376 miles of line required to connect its new gas supplies, 355 of which will comprise an extension of its system into southeastern Louisiana. About 45% of pipe lowered in on Louisiana portion. Completion scheduled for early summer.

WESTCOAST TRANSMISSION CO. LTD., Calgary. To build 650-mile, 30-in. line from Peace river area to near Vancouver, B. C., to connect with line of Pacific Northwest Pipeline Corp., to transport 370 MMcf daily, of which 300 MMcf is to be delivered to PNW. Work has commenced on all four sections between Peace river and International Border. Scheduled for completion in 1957.

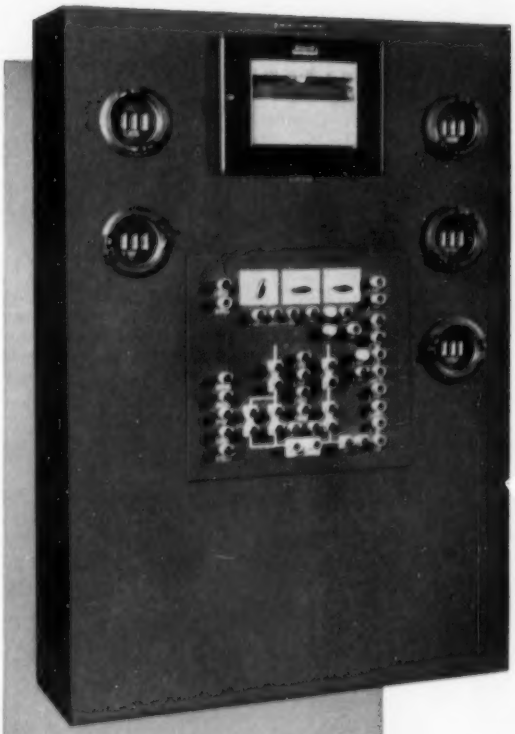
What UNION CENTRALIZED TRANSPORT CONTROL can do for you

UNION Centralized Transport Control can give you reliable remote control and indications, and monitor the data for your entire pipeline from one central dispatching office. In effect, it permits the dispatcher to function as if he were actually present at each station under his control.

A Control System for an internal combustion engine-driven gas-compressor station provides —

1. Facilities at the dispatching center for starting and stopping the engines.
2. Means at the dispatching center for controlling engine speed and discharge pressure.
3. Means at the dispatching center for remote adjustment of discharge controller "set point," fast or slow with a fineness of one part in 999.
4. Means at the compressor station for automatically sequencing the start-up and shut-down operations initiated either remotely or locally.
5. Complete function position information in the form of lamp indications.
6. Complete monitoring of actual variable readings sent to the dispatching center, such as starting air pressure, engine R.P.M., suction pressure, discharge pressure and discharge pressure "set point," including trend recording at the pressure dispatching center.
7. Complete automatic shut-down alarm system for the dispatching center, including deviation of discharge pressure from the "set point."

UNION Centralized Transport Control can be used anywhere on pipeline layouts, gas distribution systems, gathering systems, tank farms and offshore installations. It has been thoroughly proved in service and is backed up by experience in centralized control covering more than 25,000 miles of long haul transportation. Write for booklet 1052 for information on your single or multiple station control requirements.



UNION CONTROL PANEL
for a gas-compressor station.

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DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY
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MICROWAVE COMMUNICATIONS:

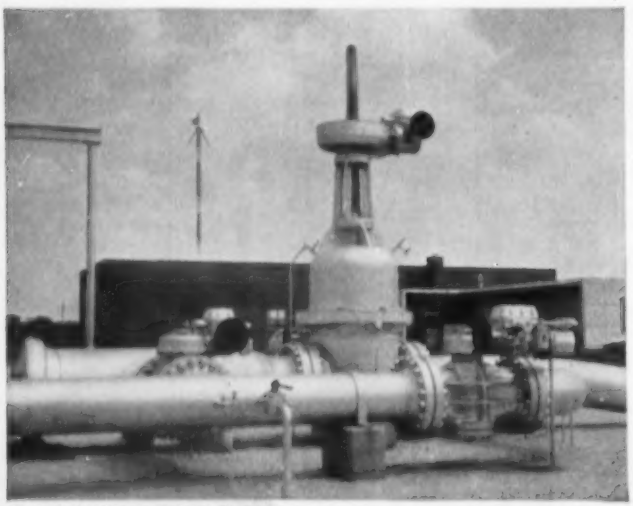
Public Service Company of Indiana, Inc.

Microwave radio aids in controlling supply of electricity for the state of Indiana. Four branches of a G-E Microwave system—combining voice and telemetering channels—originate at utility headquarters in Plainfield. From this hub regional demands are controlled according to local needs. Load control information obtained by remote control telemetering is analyzed, then transmitted to generating stations in necessary areas. Entire electrical power system is linked solidly by microwave radio.

Busy Tower

Antenna receives, transmits, or relays voice or telemetering signals. Antennas like these link headquarters with generating plants and sub-stations over a wide area.

P.S.I.'s microwave network provides utmost dependability because of standby equipment, fail safe feature, and because equipment can be concentrated at specific locations where it can be fully protected and easily maintained.



Sinclair Pipe Line Company

Microwave radio helps Sinclair coordinate flow of crude oil and oil products over many states—even turns pumps on and off. 7 voice, 4 telemetering channels link Cushing, Oklahoma and East Chicago, Indiana. Another channel permits remote control of 16 VHF radio base stations along the line which provide communication between over 100 radio-equipped vehicles and any company office in the microwave system. System is capable of providing up to 12 additional channels as needed.

Are microwave circuits your answer, too?

It depends.

What kind of service do you provide, how do you do it?

Let's assume that instant control and coordination of many functions, over long distances, are vital to your needs. Then you *should* investigate microwave because it is dependable, economical, and inexpensive to add additional circuits.

The services shown here *need* dependable voice and signal circuits. One controls the flow of crude oil and oil products over many states. The other uses microwave to link electric power facilities throughout one state.

Both use G-E Microwave Equipment for efficiency and economy. For additional microwave information, write: *General Electric Co., Microwave Equipment, Sect. X1366, Electronics Park, Syracuse, N.Y.*

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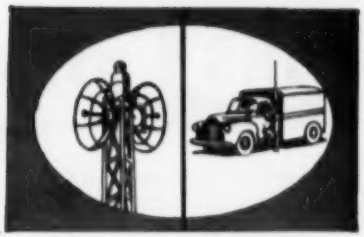


By FRANK CHAPMAN

More on lease-maintenance

The subject of lease-maintenance agreements, particularly with reference to the recent consent decree entered into between the A. T. and T. and Western Electric and the Anti-Trust division of the Justice department, continues to occupy the center of the stage for gas company communications men.

Among the recent developments was the filing by the Bell Telephone Company of its tariff with the California Public Utilities Commission, with an effective date of April 30, to make lease-maintenance facilities available at uniform rates to private mobile radio users coming under the jurisdiction of the California commission. The tariff was filed in an apparent attempt to comply with the recent consent decree.

In addition, on April 19 Roger Arneberg, city attorney for the City of Los Angeles, filed on behalf of the municipal corporation a formal protest to the PUC's order.

In essence, the protest filed by the City of Los Angeles alleges that no authority exists under Section 454 of the Public Utilities code for the filing of the proposed schedule and that the rates under the proposed schedule apply to non-public utility services and, therefore, do not fall under the jurisdiction of the commission.

The city's protest also recalls some of the arguments heard before the state public utilities commission recently in connection with the sale by the two southern California gas companies of their radio communications facilities to the local Bell System company on a lease-maintenance arrangement. For instance, it is argued that it has not been established that the rates proposed in the schedule will be compensatory to the telephone company. The protest also argues that it has not been shown that the telephone company has the financial ability or resources, skilled personnel or adequate equipment to meet the demands which may follow this public offering.

Finally, the protest argues that the activities and services proposed constitute an unlawful restraint of trade and commerce, and a monopoly under the Sherman anti-trust act, and would contravene the consent decree recently entered by the U. S. district court involving the A. T. and T. and Western Electric Co.

In still another development, Rep. James Roosevelt of California has issued a strong statement censuring the role of the Department of Justice in the recent consent decree. He has charged that the consent decree has done nothing to break up a tight monopoly but that it is instead "a betrayal of the most basic principles of our anti-trust laws which Attorney General Brownell has sworn to uphold."

NCUR meets in Omaha

The matter of split-channel operation came in for a major share of the discussion at the recent annual meeting of the National Committee for Utilities Radio in Omaha, Neb. In reporting upon comments presented to the FCC, the executive council of the NCUR pointed to the increasing possibility of interference to power utility radio operations because of increased crowding in the power radio service, because of the increased use of the same frequencies for other services in foreign lands, particularly where the forward scatter technique for over-the-horizon communication is used; and because of the increased incidence of long distance or "skip" interference due to the growing sun spot activity.

The committee's comments suggested that the need for additional usable frequencies in the power radio and other services may call for a carefully engineered split-channel plan in combination with a general review of frequency allocation including those now reserved for government use. The comments objected to the close frequency tolerance and the five kilocycle limitation on deviation for modulation specified in the docket as impractical in the present state of the art and unnecessary to obtain satisfactory operation with the proposed channel separations. For the 152-162-mc band, the comments proposed establishment of channels with 15-kc separation, but assignment in any one area on alternate channels.

It was announced at the meeting that further study is to be made by the executive council to reach an early solution to problems of engineering, frequency coordination and operating procedures raised by the split channel proposal. The members of the committee were warned that no assurance has been afforded that new channels made available by split channel techniques will be allocated to the service to which the orignal unsplit channel was allocated.

The committee directed the executive council to form a working group to study new uses of radio by the utilities in an effort to increase the efficiency of their current operations. It was reported that following a directive from the previous annual meeting, the council has petitioned the FCC for a rule change to permit use of Power Radio Service manned base and mobile stations on an incidental basis to send coded tone signals to fixed receivers to perform control functions. No automatic check back is contemplated in this petition.

By unanimous vote of the committee T. G. Humphreys Jr., Alabama Gas Corp., was elected chairman for the coming year. Other officers elected were: George E. Carlson, Consumers Public Power District, vice chairman; and John Slothower, Northern States Power Co., secretary.

GAS pipeline news

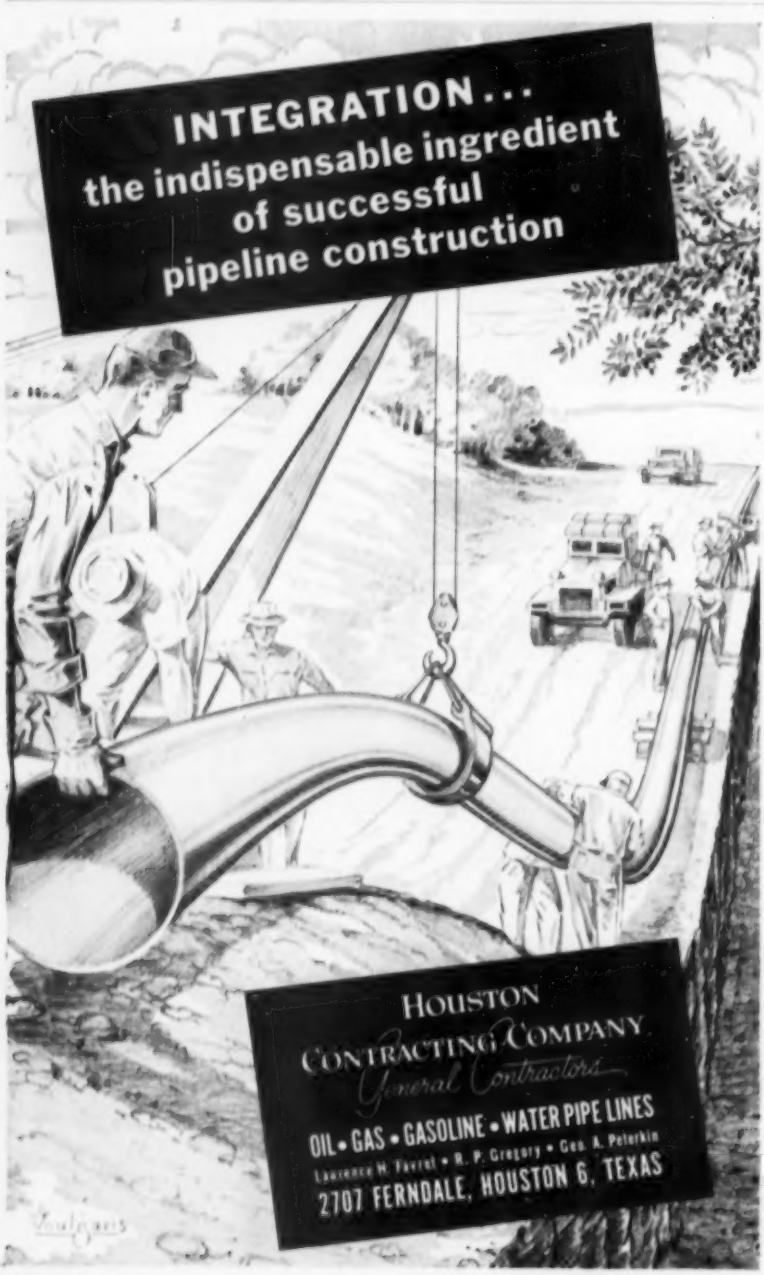
Escalation, favored-nation clauses hit by FPC rule

Texas attorney general John Ben Shepperd, has informed the Federal Power Commission that he feels a proposed rule by the commission to require independent natural gas producers to file reports on all sales of gas would be "unsupportable by law."

The proposed sales contracts containing certain types of escalation provisions and favored-nation clauses would not be accepted for filing after July 1. In its announcement, the commission stated that while it is generally desirable, for the protection of consumers, that gas purchase contracts by interstate pipeline companies cover periods of maximum duration rather than only short limited periods, but declared that contracts such as those which it described "are not in the public interest and should not be accepted for filing or given formal recognition merely for the purpose of extending the reserve contract period."

In a letter to FPC Chairman Kuykendall, Mr. Shepperd said the rule under consideration would be "in direct and open conflict with the expressed intent of Congress and a capricious exercise of an authority not possessed by the Federal Power Commission."

"The only purpose to be served by FPC control of gas is the oft-cited 'consumer interest.' Even that interest," the letter continued, "if it is indeed served by FPC, would not extend to sales wholly within this or any other production state. The commission might logically be interested in the price of Texas gas sold in Boston, Mass., but it cannot justify an interest in Texas gas sold in Boston, Texas."



Condemnation ruling favors Pacific Northwest

Washington's supreme court has denied a request to block condemnation of a piece of property, thus removing an obstacle from the path of the Pacific Northwest Pipeline Corp.'s line across the state.

The court action was brought by Seattle's city comptroller, W. C. Thomas, his wife, and 14 neighbors as owners of property near Issaquah. They appealed to the state supreme court after the King county superior court ruled with the pipeline company.

The group contended that the superior court lacked jurisdiction to hear the condemnation proceedings, and that Pacific Northwest followed a wrong procedure in its condemnation action.

Trans-Canada promised $80 million government loan

A Canadian government loan of $80 million has been promised Trans-Canada Pipe Lines Ltd., which sees a start of its 2350-mile line from the gas fields of Alberta to eastern Canada this summer.

Trade Minister C. D. Howe, in a statement to the House of Commons, said the loan will represent 90% of the cost of building the first 600-mile section from the Alberta boundary to Winnipeg, Manitoba. The loan will bear 5% interest.

Trans-Canada has pledged all its assets to repay the loan by March 31, 1957. If it fails to do so, the govern-

IT'S NEARING COMPLETION... PACIFIC NORTHWEST PIPELINE'S "SCENIC INCH"

Winding across New Mexico's deserts, climbing the snow-capped Colorado Rockies and ending at last in the evergreen country of Oregon and Washington . . . Pacific Northwest Pipeline Corporation's 2300-mile "Scenic Inch" is being rushed to completion.

This $209,000,000 pipe line project will soon deliver over 343,000,000 cu. feet of natural gas per day to aid the expanding economy of the Northwest.

Working closely with Pacific Northwest Pipeline Corporation on the "Scenic Inch" is Kaiser Steel—a major supplier of line pipe on this project.

Next time you are ordering line pipe, think of Kaiser Steel. Rely on Kaiser Steel quality and service to add dollars to your operating profits.

Kaiser Steel

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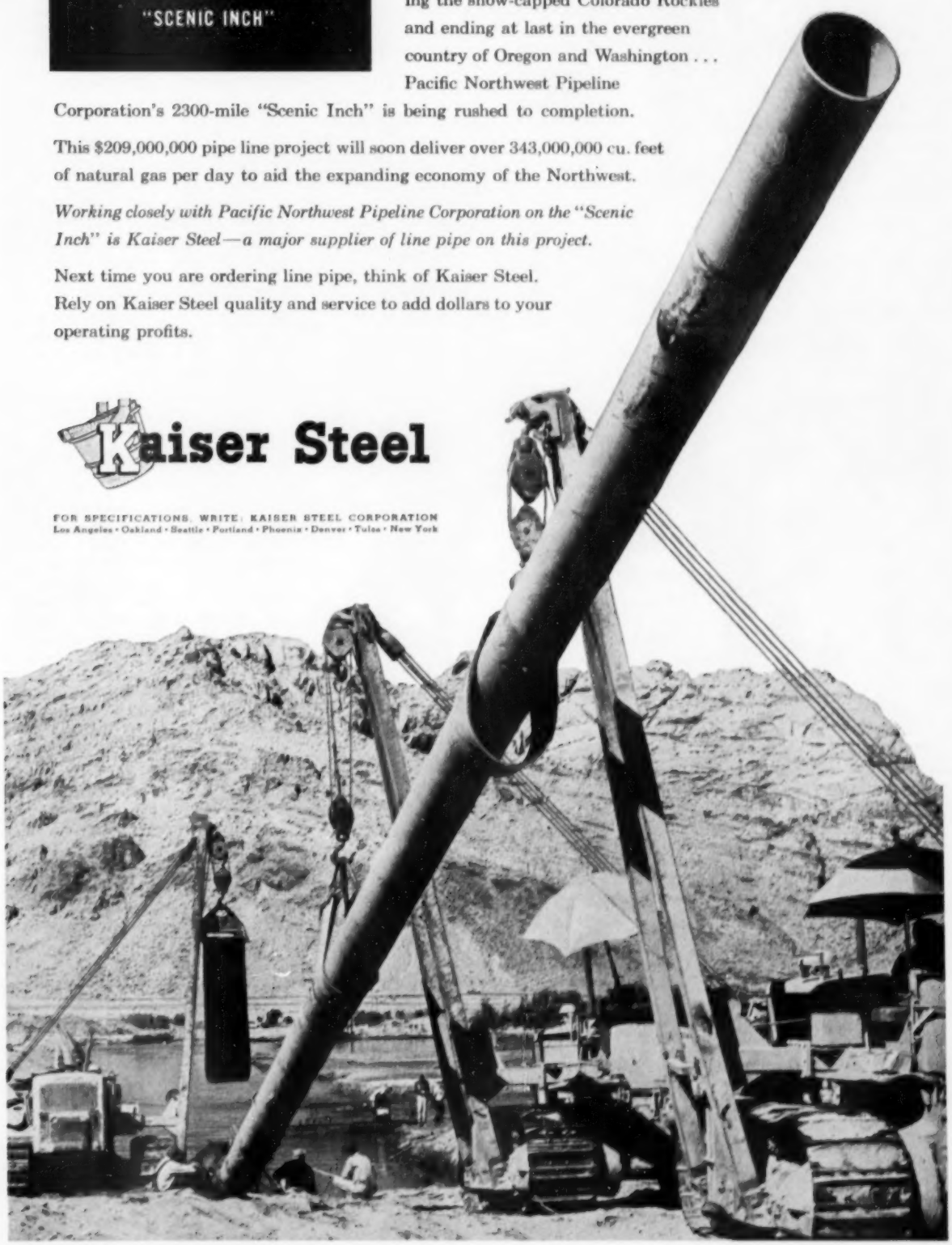

ment has an option to take over the project.

Mr. Howe expressed confidence that a proposal before the U. S. Federal Power Commission (Midwestern Gas Transmission, et al) to permit import 200 MMcf/day would be approved. Such approval is considered necessary to the success of the enterprise. He said, however, that it is desirable to begin construction without waiting for the decision to avoid any further delay.

The loan must be approved by Parliament and Mr. Howe's statement met a storm of protest from opposition parties. George Drew, leader of the Progressive-Conservative party, described the loan as a "strange and unique proposal for making Canadians finance an American-controlled venture."

Total cost of the line is estimated at $350 million. From Alberta to Winnipeg, it will be 34 in. in diameter and a branch will carry the 200 MMcf to the border. The rest of the line is to be in 30-in. to carry 300 MMcf/day.

The Canadian Parliament is also considering a proposal to cooperate with Ontario to form a $118 million Crown corporation to finance the 675-mile northern Ontario leg of the project.

Donald Deacon, vice president of Winnipeg Central Gas Co., has offered another solution to the Trans-Canada problem. He believes that if all Canadian gas companies seeking gas for their areas will chip in to pay the cost of the proposed line, the new line's financing problems will be solved. As a start, he has offered a $1 million, interest-free loan to Trans-Canada Pipe Line.

Increases contemplated in contract disallowed

An FPC examiner has filed a decision which holds that rate increases totaling about $2.7 million annually sought by four independent producers should be denied because the applicants had not sustained their burden of proof in showing that the proposed increases "are just and reasonable," despite the fact that the increases were contemplated in the contract.

In his opinion, Examiner Zwerdling denied the motion by applicants to terminate the proceedings for lack of jurisdiction on grounds that the Mobile decision (GAS, April, p. 172 and May, p. 11) was applicable. He maintained that the increases involved resulted, not from unilateral action, but "represented contract changes made by mutual agreement" between the producer applicants and the pipeline company "by negotiations in which neither the distribution companies nor the ultimate consumers were involved, and where they accordingly had no opportunity to protect their interests," protection of such interests "against exploitation at the hands of natural gas companies" being held as a primary aim of the Natural Gas Act.

Transcontinental Gas Pipe Line Corp., which is the transmission company involved, intervened in support of the applicants during hearings in the consolidated proceedings.

Examiner Zwerdling, pointing out that at the first session of the hearings the producers presented evidence as to arm's-length bargaining and of field prices, said the FPC in this and other proceedings has made it clear that while such evidence deserves consideration, it is not sufficient alone to sustain the producers' burden of proof.

After the second set of hearings allowed by the commission, the examiner said the producers' case was "in no better or different posture . . . than at the end of the first hearing."

He further said that his decision "rests not merely upon any claimed deficiency in the particular type of field price evidence here presented . . . but rather upon the square holding that field price evidence is in no event suf-

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HEAVY DUTY WHEELS

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Standard ¾", ⅞", or 1" thicknesses, or to specification.
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Shipped ready for installation.

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When Line Pipe Wears A STRAIT-JACKET

Open section of Hydropress is shown only to illustrate operation. Length of pipe is completely encased during expansion.

THE "Strait Jacket" is an important step in the Youngstown process of producing high strength line pipe to API-5LX specifications. This "Strait Jacket" is actually a hydraulic expansion unit in which the pipe is expanded within a set of enclosed dies. In this operation the ends are sealed, water is forced into the pipe and pressure is increased to expand it evenly against the smooth steel walls of the expander.

This process proof tests and cold works the pipe simultaneously. As a result Youngstown Electric Weld Line Pipe with uniformly high strength, with uniform weld quality, with uniform straightness, with uniform wall thickness and with uniform diameter is ready for you.

* * * * * *

Five reasons why Youngstown Electric Weld Line Pipe is your best buy: (1) It bends readily; (2) Wall thickness is uniform; (3) Line up characteristics are excellent; (4) Weldability is outstanding; (5) Long lengths save you time and trouble. The Youngstown Sheet and Tube Company, Youngstown 1, Ohio. Sales and service offices throughout the oil and gas producing areas.

Youngstown

ELECTRIC WELD LINE PIPE

QUALITY YOUNGSTOWN SERVICE

THE YOUNGSTOWN SHEET AND TUBE COMPANY *Manufacturers of Carbon, Alloy and Yoloy Steel*

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Lone Star Steel is a major supplier to the great Pacific Northwest Pipeline

The superiority of Lone Star API pipe is built in. There's quality control in every step... starting with top quality iron and steel scrap, then going through the vast open hearth furnaces, the soaking pits, rolling mills and finally through the pipe mills.

Lone Star line pipe is renowned for its bending quality and workability . . especially important in the rugged Pacific Northwest country. Veteran pipeline men are strong in their praise that Lone Star pipe speeds construction.

Neighbor, wherever you are, specify Lone Star . . and we both get a good deal!

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pipeline news • *Cont'd.*

ficient to sustain a proposed rate increase." If producer rates are to be fixed upon the basis of field price alone, without interference to economic information relating to the financial interest or needs of the applicant, the "just and reasonable" standard of the Act becomes "merely a vehicle for approving and rubber-stamping all new contract prices arrived at in the absence of collusion, so long as they do not exceed the levels already reached, in the absence of regulation, under existing contracts."

Turning to the applicants' motion to terminate based on the Mobile case, Examiner Zwerdling said that in considering these motions it is important to focus attention upon and keep constantly in mind the concrete situation which was before the Supreme Court in the case. The court held there, he continued, that the question at issue was "whether natural gas companies are empowered to 'initiate' unilateral contract changes under Section 4 (d)," and commented that the court answered this in the negative.

In conclusion, he said it was "extremely puzzling to find the producer-applicants here citing the Mobile decision as the basis for a contention that the commission could not lawfully suspend the effectiveness of the increased rates here involved. The gist of the Supreme Court's decision in the Mobile case was that where a natural gas company enters into a contract with a customer at a given rate, it is required to live up to that contract; that unless the customer thereafter agrees to a rate increase, the rates cannot be changed simply because it suits the private interests of the seller, but only if the commission, in the exercise of its responsibility to protect the consumers, finds that such an increase is required by the public interest.

"But what the instant producers ask us to hold here is that this avowed purpose of the Supreme Court to protect the consumer from exploitation somehow becomes translated also into an intent to wipe out the protection against improper rate increases which Congress has afforded to the consumer under Sections 4(d) and (e) of the Act—in all cases where a producer and its pipeline customer have mutually agreed upon an increase in their contract rate, by negotiations in which neither the distribution companies nor the ultimate consumers were involved, and where they accordingly had no opportunity to protect their interests.

"Such a result was clearly not intended by the Supreme Court in the Mobile case, and it is in fact directly contrary to the express language of the court in

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FOR ACCURACY!

USE BELL SYSTEM PRIVATE LINE TELETYPEWRITER SERVICE

Pipe line companies find that Bell System private line teletypewriter service gives them the fast, written communications they need in today's competitive market.

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that decision. Furthermore, no rational basis has been suggested as to why such a result could possibly have been intended or desired under an Act whose 'primary aim . . . was to protect consumers against exploitation at the hands of natural gas companies.'"

Pacific establishes Salt Lake headquarters

Salt Lake City has been selected as the location for permanent operating headquarters for the Pacific Northwest Pipeline Corp., C. R. Williams, president, announced recently.

Selection of the Utah city was made definite by Pacific's board after considerable study and deliberation. Salt Lake is near the geographic center and easily accessible for operation of the new 2200-mile pipeline system.

During the coming months, Salt Lake will become the nerve center of the far-flung Pacific facilities. Administrative and operating activities will be directed from offices there. Field operating locations are being set up at various points on the line to supervise production facilities, compressor and metering stations, patrol and maintenance activities, and related services.

Fish Northwest Constructors Inc., builders of the line, has had construction headquarters in Salt Lake City since construction began a year ago.

Pacific Northwest personnel will soon be transferring from the present Houston offices, and plans have been developed for the orderly transfer of equipment and personnel to cover several months. Chairman of the board, Ray C. Fish, also president of Fish Engineering Corp., will remain in Houston. Among top officials who will establish offices in Salt Lake are Mr. Williams; R. C. Frederick, Allen B. Hiatt, A. B. Allyne, and J. M. Clark, vice presidents; and C. A. Watson, treasurer.

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FPC Commissioner Draper retiring in June

Commissioner Claude L. Draper, who has been a member of the Federal Power Commission since it was organized as an independent agency in 1930, will retire when his present five-year term expires next month.

Commissioner Draper, who is the dean of the FPC in point of service, has served under four presidents. Prior to his appointment to the commission in 1930, Commissioner Draper was vice president of the Association of Practitioners before the Interstate Commerce Commission and chairman of the committee on freight rates of the National Association of Railroad and Utilities Commissioners.

Trunkline must revise tariff, says FPC

Trunkline Gas Co.'s natural gas tariff should be revised to provide for a credit equal to the average amount of federal income tax accruals in computing the amount of the working capital allowance for inclusion in the rate base, according to an order issued by the FPC.

The commission held that Trunkline's present tariff "is unjust, unreasonable and unduly discriminatory insafar as it does not provide for a credit against working capital of 65.55% of the Federal income tax expense included in the cost-of-service billed to the buyer for the proceding 12-month period."

Trunkline had maintained that tax accruals in excess of the amount constantly on hand, approximately 33.34% could not be used for working capital purposes. The FPC, however, declared that the company's argument results "from a failure to give effect to a basic concept of rate regulation," that

fundamentally rates are not designed to cover day-to-day fluctuations in the rate base, but that instead averages should be used.

The commission's ruling resulted from an investigation instituted last year of the company's rates insofar as they relate to working capital. The investigation was initiated following the institution of a rate suspension proceeding involving Trunkline's affiliate, Panhandle Eastern Pipe Line Co., Kansas City, Mo. Panhandle, which is seeking an increase of over $12 million annually in its rates, submitted in support of its proposal the stated cost of substantial volumes of gas purchased from Trunkline. The effect of the commission's decision is to reduce the charges by Trunkline to Panhandle and consequently to reduce Panhandle's costs of service.

FPC Presiding Examiner Ewing G. Simpson in an initial decision filed last January granted Trunkline's motion to dismiss the investigation proceedings after accepting the company's argument that the income tax credit against working capital requirements should be made only to the extent that the tax accruals are constantly available.

The commission pointed out that working capital, as an item in the rate base upon which Trunkline is permitted a return, represents the capital supplied by investors. However, the FPC continued, when funds available for working capital are supplied by ratepayers and result from the annual lag in income tax payments, Trunkline has available to its funds which offset capital requirements otherwise to be supplied by investors. "To the extent income tax accruals are available from the ratepayers, it is inequitable to require them to pay a return upon working capital," the commission asserted.

Work on substitute line for Little Inch continues

Temporary authority has been granted to Texas Eastern Transmission Corp., Shreveport, to continue construction and operation of gas facilities designed for substitution for the portion of the Little Inch which the company proposes to retire from natural gas service. The temporary authority, however, does not permit the proposed abandonment of the Little Inch facilities.

George T. Naff, Texas Eastern head, says a recent report from the Office of Defense Mobilization to the effect that the government sees no need from the defense standpoint for additional oil pipelines between the Gulf Coast and eastern markets will have no effect on the company's plan to reconvert a sec-

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tion of the line to petroleum products service.

Texas Eastern doesn't expect the hearings now before the FPC to be resolved in time to effect the reconversion prior to the 1956-57 winter heating season, in which case the line will be retained in gas service until the winter heating season has passed.

Westcoast Transmission completes financing

Financing of the $154 million Westcoast Transmission Co. line has been completed.

A unique feature of the final agreement is that Canadian control of the line from Alberta to British Columbia is assured. Approximately 64% of voting shares will be under the control of six voting trustees, four of whom must be Canadians.

It will be the largest single bloc of privately financed capital ever to come into western Canada.

North Dakota PSC law is hearing issue

Hearings got under way late last month in North Dakota on the dispute over the construction and operation of a line from Tioga to Minot which Montana-Dakota Utilities Co. built without a certificate of public convenience and necessity from the North Dakota Public Service Commission. (See GAS, January, p 130.)

PSC President Martin Vaaler dissented from the commission's hearing order, saying, "It is my understanding that the legal issues of whether Montana-Dakota is or is not required to obtain a certificate to construct and operate a natural gas pipeline . . . is at issue now on appeal before the district court at Minot." It is his feeling, he added, that the hearing was called to "harass" the company.

Commissioner Ernest Nelson, who approved the hearing along with Commissioner Anson Anderson, explained that it was the feeling of the commission's legal staff counsel that the appeal by MDU at Minot, which involves all facts of pipeline operation, "is not a direct test of the powers of the commission and may not go to the root of the matter."

"What we want to know," he said, "is if through the years we have been spending taxpayers' money and wasting our time on hearing these cases involving matters where there is a question of whether we have legal authority to rule.

"We didn't call the hearing to em-

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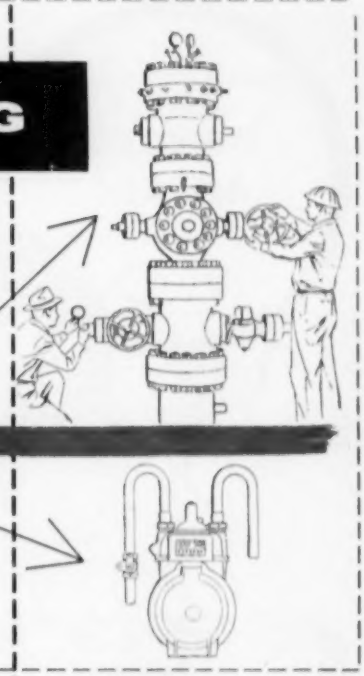

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pipeline news • *Cont'd.*

barrass MDU. It was called for the sole purpose of clarifying the certificate law by adjudication." He said it was the opinion of the commission's counsel that such a hearing would be necessary to lay a proper foundation for such a legal test.

Ledeen breaks ground for new headquarters

Ground-breaking ceremonies for new headquarters were held recently by Ledeen Manufacturing Co. at the site of its new plant in El Monte, Calif. The new plant will also serve as headquarters for Engineering Products Co., a subsidiary, distributing mechanical power transmission and materials handling equipment.

The building, consisting of an office, machine shop, and warehouse, will cover an area of approximately 30,000 sq ft. Acoustical ceilings, fluorescent lighting and modern color treatment will be used.

High court's unilateral ruling brings new action

Hearings were scheduled to begin at the FPC late last month on motions filed by several wholesale customers of United Gas Pipe Line Co., Shreveport, to reject increased rate filings by the company.

The rejection motions were filed by the wholesale customers because of the U. S. Supreme Court's ruling (see GAS, April, p 172 and May, p 11) that rates established by contract may not be unilaterally changed by one of the parties to the contract.

In reply to the motions, United claims that the service agreements grant either party the right to seek changes in accordance with the Natural Gas Act, and that the tariff, including the form of service agreement, is *ex parte* and may be changed unilaterially. Texas Gas Transmission Corp. and Southern Natural Gas Co., both customers of United, support United's position.

The commission, however, said that the motions, in light of the recent high court decisions, raise questions which are not answered conclusively by the responses.

New W-K-M plant combines three production facilities

A new W-K-M Manufacturing Co. came into being last month, along with the opening of a new 12-acre, multimillion dollar plant on a 75-acre site at Missouri City, a few miles west of Houston.

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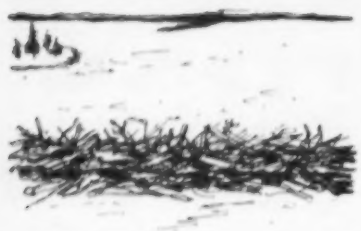

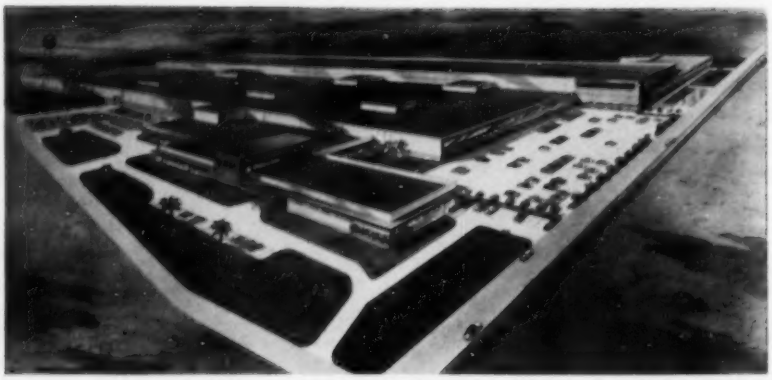

Machinery from the former W-K-M plant in Houston, from the Kay plant, and the ACF Detroit plant is being set up in the new facility. New equipment essential to the expansion involved in the consolidated operation has also been installed.

The new company is a consolidation of W-K-M Manufacturing Co., Houston, a subsidiary of ACF Industries Inc., maker of gate valves; the Key Co., E. St. Louis, manufacturer of return bends and fittings; and the ACF Valve division, Detroit, producer of lubricated plug valves.

All activities of the three concerns will be concentrated in the new plant, which has been designed so that each will function as a distinct manufacturing operation with individual production lines for each product.

With the exception of second-floor office space of 1200 sq ft, the plant's 12 acres of floor space is at ground level. Since offices, engineering space, reception and conference space require only 48,000 sq ft, manufacturing plant alone covers close to 11 acres at one floor level.

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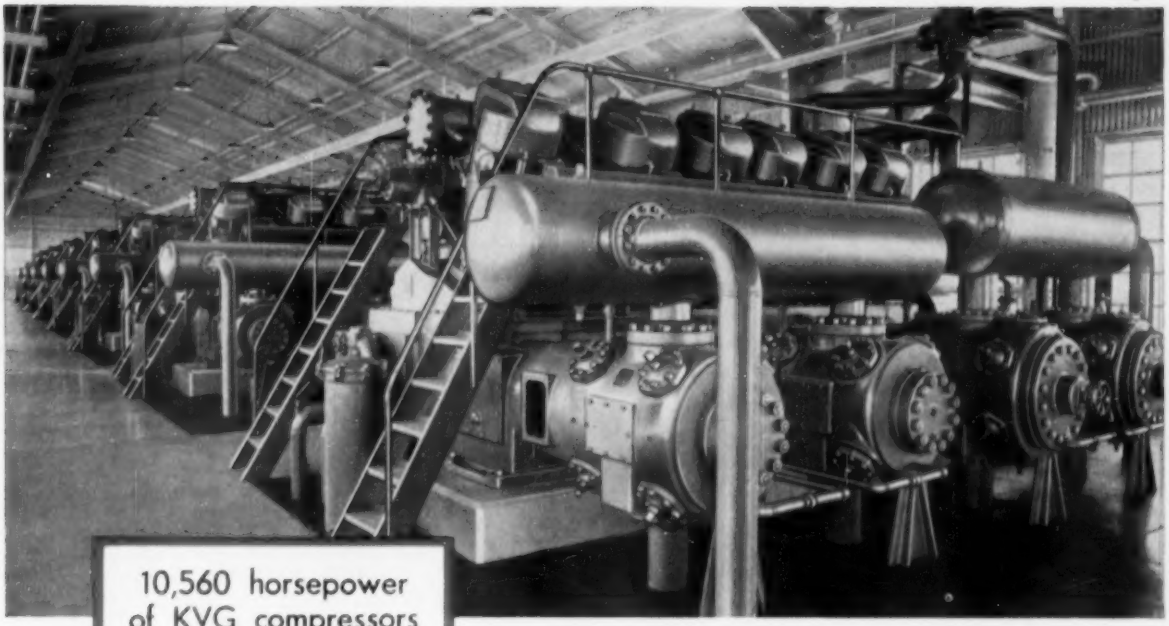
GAS pipeline notes

About $3 million will be spent during the next eight months by Arkansas Louisiana Gas Co., Shreveport, in a search for new gas reserves to meet unprecedented demands. The search will center in Arkansas and Texas, with about half the amount to be spent in the Arkansas River valley between Little Rock and Fort Smith.

Kansas - Nebraska Natural Gas Co., Phillipsburg, Kan., will spend an estimated $1 million to install 32.7 miles of line and add compressors at five locations to increase the stations' capacities by 2700 hp (Docket G-10014). The new construction will serve increased demands of existing markets in Nebraska.

Safety Director Stanley Owens of Transcontinental Gas Pipe Line Corp. has been notified that Transco won an Award of Merit from the National Safety Council. During more than 3,250,000 manhours worked by pipeliners in 1955, only 25 loss-of-time injuries occurred. Transco's safety director said that 20 of the company's 29 compressor stations and pipeline districts achieved perfect safety records during the year.



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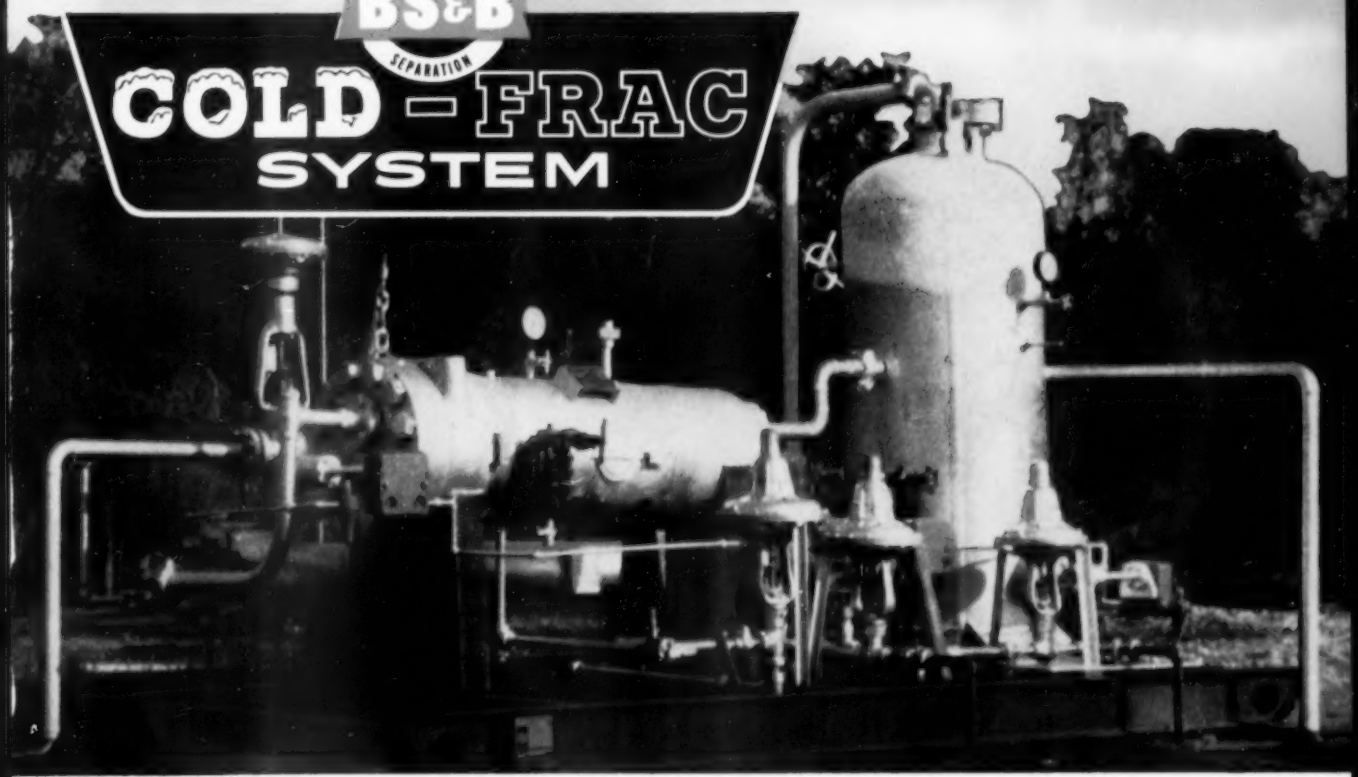

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